Nature,
June 14, 1906

Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME LXXIII

NOVEMBER, 1905 to APRIL, 1906

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

London
MACMILLAN AND CO., LIMITED
NEW YORK: THE MACMILLAN COMPANY

INDEX.

Reviews and Our Bookshelf.

Literary Supplement.

INDEX TO LITERARY SUPPLEMENT.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

THURSDAY, NOVEMBER 2, 1905.

TWO TEXT-BOOKS ON MECHANICS.

An Introduction to the Design of Beams, Girders, and Columns in Machines and Structures, with Examples in Graphic Statics. By W. H. Atherton. Pp. xiv+236. (London: Charles Griffin and Co., Ltd., 1905.) Price 6s. net.

Mechanics for Engineers, a Text-book of Intermediate Standard. By Arthur Morley. Pp. xi+282. (London: Longmans, Green and Co., 1905.) Price 4s. net.

MR. ATHERTON'S book is for engineering students whose mathematical knowledge does not include the calculus. and such readers will find it a very useful source of information.

The style is very unconventional—a trait which is rather helpful than otherwise—but occasionally the disregard of grammatical niceties and the ordinary rules of composition is carried too far.

The author does not trouble himself in the least about discussions as to absolute and gravitation units of force and the so-called "engineer's unit of mass" (which is about 32·2 pounds). He is a practical engineer, as is sufficiently obvious from the words, "There are only two units of force that will be of much use to us—namely a *pound* for light work and a *ton* for heavy work"; but there is a suggestion of an ancient conundrum about his statement, "So far as we are concerned, force is measured in terms of some unit of weight, as that of a ton of iron." Chapter vi. contains a good exposition of the theory of the bending of beams, together with some useful cautions and explanations of certain discrepancies between theory and practice. The moments of resistance of beams of various cross-sections are all calculated by elementary non-calculus methods. The calculation of moment of inertia (the absurdity of which term the author very properly emphasises) is made in the same manner. It would be a great help to students—even to those who can use the calculus—to give the *particle rule* for calculating all moments of inertia with reference to a triangular (and thence any polygonal) area; the moment of inertia of a triangular area about any axis whatever can be calculated by replacing the triangle by three equal particles at the middle points of the sides, their masses being represented by $\frac{1}{3}\Delta$, where Δ=area of triangle.

While the whole of the book will be found useful, the chapter on the comparative strengths of tubes of various forms may be specially mentioned.

Mr. Morley's work differs from that above noticed in excluding all technical knowledge and terms, so that it is suitable to all students of dynamics, whether engineers or not. It does not employ a knowledge of calculus, its range being covered by algebra and elementary trigonometry, and its scope being that of the London intermediate engineering examination and that for the A.M.I.C.E. The work adopts the plan of founding the science of force on Newton's axiom ii., so that kinetical principles precede the treatment of equilibrium (statics). The great importance of the direct application of the principles of momentum and energy is recognised at the outset by supplying a large number of excellent examples of these principles, so that the work is thoroughly modern in conception and method. There is a large and commendable use of squared paper diagrams for calculating velocities, forces, work, &c., in cases in which these are variable according to other than the most simple laws.

The poundal is, happily, not employed, but the "engineer's unit of mass" is adopted in order to save the definition of force, viz. "force is the rate of change of momentum." It is doubtful if many students are helped by this device, or if they really understand what they are doing when they say that the mass of a body is W/g. We must confine ourselves to a few brief observations on a work which we commend very highly. Is not a "knot" a speed—a geographical mile per hour? The newspapers sometimes speak of "20 knots an hour," so does the author (p. 20). It is a pity that he speaks of "accelerating forces" (p. 43, &c.), because it is

essential to teach a student that *acceleration* is the inevitable property of *every* force. The motion in Atwood's machine is calculated first by the strictly valid method of introducing the tension, and then by the old method of "mass moved $= W_1 + W_2$; accelerating force $= W_1 - W_2$, &c.," which latter should either be unmentioned, or, if mentioned, justified (if possible). The formal statement "when a force acts upon a body and causes motion, it is said to do work" (p. 48) is very dangerous doctrine. The tension of an inextensible pendulum cord certainly does no work, though it exists in the motion. Are we to suppose that safety is contained in the word "causes"? If so, the metaphysician must be heard. On the important and almost universal fallacy concerning "centrifugal force" the author is a clear and safe guide.

A large collection of the ordinary statical problems is followed by a discussion of centres of gravity, moments of inertia and rotatory motions of rigid bodies, and a chapter on graphic statics, the whole being illustrated by a large collection of very well chosen examples. M.

INDUCED RADIO-ACTIVITY.

Radium and Other Radio-active Substances; their Application especially to Medicine. By Dr. Charles Baskerville. Pp. 164. (Philadelphia: Williams, Brown, and Earle, n.d.)

PROF. BASKERVILLE'S book is disappointing. On opening a work on a scientific subject by an original worker in the field of which it treats one expects to find the original materials thoroughly digested and worked up, and the relative merits of rival theories and conflicting experimental data carefully weighed; one hopes, too, to find novel suggestions for the interpretation of existing data, and hints to guide experimental research in the future.

In the present work these things are not to be found. It may be said, broadly, that the book is no more than a collection of abstracts of original papers, put together, indeed, in some approach to a consecutive order, as regards subject-matter, but without the attempt to weld them into a homogeneous whole. We constantly find, for instance, that views which have no serious claims to attention, either from the authority of their authors or from the arguments they put forward, are treated with quite as much respect as the opposite conclusions of leading workers in the subject, which are supported by strong experimental evidence.

In some cases the author even goes so far as apparently to endorse conclusions which are opposed to his own. On p. 88 we have a picture, underneath which the following explanation is given:—

"This is a radiograph of a gold fish which had been placed in water rendered radio-active by having suspended in it for 24 hours a *closed tube* (our italics) containing ten milligrams of radium of high activity. By this process the water was rendered radio-active, and the fish was then placed in the water, and, although the radium had been entirely removed, the fish itself was rendered radio-active, and, when placed on a photographic plate, photographed itself by its own radio-activity."

As Prof. Baskerville, contrary to his usual custom, mentions no name in connection with this experiment, we assume that it is his own. None the less, we read, on pp. 92–93:—

"Piffard calls attention to the fact that no authoritative statement has been given as to the rendering of water or other substances radio-active by the presence of a closed tube of radium. He further detected defects in tubes, air bubbles, &c., and regards the statements concerning induced activity by means of closed tubes as based upon the use of defective tubes. As Curie and Rutherford have shown, induced activity requires a naked exposure to radio-active bodies."

For our own part, we have no belief in radio-activity having been produced in the fish under the conditions described. The photographic effects may have been due to imperfect closing of the tube of radium, or they may have been produced by some direct chemical effect of the fish's skin on the film. But however that may be, the author's attitude in emphasising equally two opposite statements is not intelligible. Prof. Baskerville has shown great industry in bringing together the results of different experimenters, but we cannot think that he has presented his collection judiciously.

GARDEN CITIES.

Garden Cities in Theory and Practice. By A. R. Sennett. Vol. i., pp. xix + 557. Vol. ii., pp. xii + 558. (London: Bemrose and Sons, Ltd., 1904.) Price 21s. net.

THESE two handsome volumes represent the amplification of a paper on "The Possibilities of Applied Science in a Garden City" which was read by Mr. A. R. Sennett before Section F of the British Association in 1903.

The author first deals very fully with the engineering problem involved in the laying out of garden cities. A comparison of the various plans on which the great cities of the world have been built is given in a most lucid and interesting manner, after which the author shows with many clear and convincing arguments that the best type is that known as the rectilinear configuration, which is the one he adopts —the worst of all being the curvilinear type, not only from an æsthetic, but also from a practical point of view.

An interesting account of the rebuilding of London after the great fire is given in chapter ii. The various plans, especially those of Sir Christopher Wren and Sir John Evelyn, are fully discussed. The plan of the former was more or less adopted, although all his proposals were unfortunately not adhered to, with the result that many fine architectural effects are lost to the metropolis. We cannot do better than recommend those who are interested in this important subject to read the author's own account, which should excite interest even in the apathetic. In regard to the spacing out of the area for his proposed garden city, the author has carefully considered every

detail. The proportion of the area to be occupied by the public thoroughfares, promenades, avenues, and private gardens is fully discussed. By a most ingenious and original plan of allotment, each house in the city stands in its own ground without being unduly overlooked or interfered with by neighbouring dwellings, but at the same time fitting harmoniously into the whole. Instead of the usual oblong or rectangular arrangement, the author subdivides the ground into polygonal or, more precisely, hexagonal plots. This he shows preserves a uniform frontage length, and at the same time admits of great elasticity as regards the size of the allotments which different inhabitants may desire.

The city proposed by the author would consist of three separate areas, viz. the city proper, the village with its industrial zone, and the agricultural fringe. Each department is so arranged and laid out that the maximum amount of comfort and utility is combined with the minimum amount of expense. The city as a whole is so designed that it shall be self-supporting. All needless expense and extravagance are scrupulously avoided. The artisan's dwelling is made for the artisan, and the same applies to the housing of every grade and class of society. All are suitably provided for. Public buildings and offices, railway stations, &c., are grouped together within easy access of each other in the centre of the city.

The sanitary and hygienic conditions of every kind are treated in an able and scientific manner. Every health-promoting device that ingenuity can suggest is brought forward in its proper place. It is beyond the scope of a review to mention these in detail. Suffice it to say that nothing is suggested which cannot be easily put into practice; and, further, many of the author's valuable and common-sense suggestions might with great advantage be adopted in our present cities.

The sociological aspect of garden cities is treated in a rational and scientific manner. The doctrine of "equality" which was urged by some when the site of the first garden city was acquired is relegated to its proper place by the author, who reminds his readers that the outcry for equality has proved the curse of industrial England, and points out the absurdity of ranking the "loungers- the quasi-inert and industrially passive atoms—as of equal national value to the active workers or energy-imparting unit." The decentralisation of industry is one of the great objects of garden cities—hence the authorities can deal with nothing below the industrial unit.

Under the heading "Charity" the problem of dealing with the poor and infirm is discussed. The various pitfalls and dangers attendant upon indiscriminate charity are shown by actual examples. The problem is a serious one; but in this, as in other cases, the author finds a way of overcoming the difficulty, especially as regards garden cities which are untrammelled by established practice or tradition, and where methods such as the Elberfeld system, so successfully adopted in the town of that name and in Leipzig, and which the test of time—half a century - has proved to be sound in principle, might quite easily be put into practice.

The work contains a wonderful amount of valuable information written in a readable style, while the illustrations are numerous, well chosen, and admirably reproduced.

OUR BOOK SHELF.

Elementary Experimental Chemistry. By A. E. Dunstan. Pp. viii + 173. (London: Methuen and Co., 1905.) Price 2s.

So many books on elementary chemistry have been published within the last few years that it is rather difficult to imagine why any more should be written, unless there is something strikingly novel in the style or matter of the book. For anything novel we search in vain in the little book before us.

After being introduced to the metric system, in chapter ii. the student is supposed to find out the difference between chemical and physical changes by having to note the effect of heat upon sulphur, lead, magnesium, and sugar, and at the end of each experiment he has to state whether the change is physical or chemical. Chapter iii. deals with air, chapter iv. with active air. In chapter x. we come to solution, which to our mind would have been better treated earlier.

Formulæ are not mentioned until p. 130, and on p. 131 the union of atoms to form molecules is shown in a diagrammatic manner which we venture to think will leave the student very little wiser than before. Almost all through the book the equations are written in words and not expressed in symbols, as, for example, zinc + sulphuric acid = zinc sulphate + hydrogen. This is not necessarily objectionable in an elementary book, but to formulate all the equations which occur in the course of the book in an appendix is simply wasting type, because the student will never look at them. Furthermore, will the student understand the action of nitric acid upon copper by writing the equation in this manner?

$$2HNO_3 \left\{ \begin{matrix} 2\,N\,O \\ H_2O + 3Cu = \\ 3\;\;O \end{matrix} \right\} 2NO + H_2O + 3CuO.$$

It is then explained that the copper oxide is acted upon by a further quantity of nitric acid, &c.

Some of the experiments which the student is supposed to carry out are more for the lecture table than for the laboratory. For instance, on p. 121 the student has "to find the proportions in which oxygen and hydrogen combine to form water." Dry hydrogen and oxygen have to be collected in a eudiometer *over mercury* and then sparked. On p. 122 a similar experiment has to be carried out, but in this case to show the volume of steam formed. These are not experiments for elementary students, and we doubt whether the author himself allows his students to carry them out.

The book is very fully illustrated, and some of the exercises are undoubtedly good, but for the book to be really useful to the student will require a considerable amount of discrimination on the part of the teacher as to what experiments the student can himself be trusted to work out.

Wayside and Woodland Blossoms. By Edward Step; with coloured pictures by Mabel Step. First series, pp. xiii + 176 + 127 plates. Second series, pp. xv + 171 + 127 plates. (London: Frederick Warne and Co., 1905.) Price, each volume, 6s. net.

ABOUT ten years ago Mr. Step prepared two handy little volumes which many country ramblers have

found of service in identifying British wild flowers and discovering something about their affinities and the significance of their structure. These volumes have now been completely re-arranged, and the plates have all been newly drawn, so that the revised edition is substantially a new work. In the original books, plants were roughly arranged in the order of the seasons in which their flowers appear, but in the present volumes a more natural grouping is followed, series i. containing representatives of the plant families from the Buttercups to the Composites inclusive, and series ii. from the Composites to the Grasses and Ferns. This arrangement is much more instructive than the former one; and in connection with the descriptions of family characters given at the end of each volume it should facilitate the further study of plants in more elaborate works.

The coloured plates in the two volumes are, with few exceptions, very fine, and will enable the country rambler easily to identify the flowering plants he meets. In almost every case the pictures are truer to nature than those in the original volumes, though these left little cause for complaint. The picture, for instance, of Lady's Smock is much superior to that in the old edition; so is that of Germander Speedwell. The Chicory flower, however, is better represented in the old volume than in the new; and in neither is the illustration of Tamarisk satisfactory. The ideal way to depict flowers for purposes of identification would be to take tri-colour photographs of the flowers and reproduce them by the three-colour process of printing. This method, which has been successfully adopted in the illustration of a few natural history objects, might have been profitably used by Mr. Step instead of lithography. No doubt there are difficulties to be overcome, but they are not very great, and success should attend the work in which the advantages of colour photography are brought into requisition. But while we await these faithful photographic reproductions, it is good to possess Mr. Step's two pocket guides with their clear descriptions and plates, and we are glad that such attractive books exist to awaken interest in plant life.

Quiet Hours with Nature. By Mrs. Brightwen. Pp. xvi+271. (London: Fisher Unwin, 1904.) Price 2s.

MRS. BRIGHTWEN'S books no longer need to be recommended to beginners in natural history. A fresh collection of her simple and sympathetic accounts of animal and vegetable life as studied and enjoyed in her own garden and park is sure to be welcome to all boys and girls who have once begun to take an intelligent interest in natural objects. All we need say about this volume is that, besides some pleasant papers about her tamed wild animals, including squirrels, field-voles, a rook, and even a stag-beetle, which followed his benefactor across the lawn, it contains others on the trees in her garden and some of the plants in her conservatory, all well calculated to arouse just such an interest in common things as may carry the young reader on to more exact and elaborate studies of nature. The book is charmingly illustrated by photographs and drawings.

One word of criticism may be allowed. It is surely as well, in introducing young folks to the study of nature, not to lead them to think that there is an essential difference between the "professional" entomologist or ornithologist and the ordinary observant field-naturalist; or if there be a real difference, it may be as well not to emphasise it. On p. 191 Mrs. Brightwen quotes a scientific description of the head of *Eristalis tenax*, with the comment:—"Now this may be very interesting to a professional entomologist, but it does not convey much information to an ordinary reader, and yet this is the scientific description of my drone-flies, interesting creatures which I kept through a whole winter until they were coaxed into the circle of my winged friends." It is true that the description conveys but little to an "ordinary reader," but a very little trouble will make it convey a great deal, and this small amount of trouble, or of instruction if it can be had, is exactly what our young "nature-lovers" should be encouraged to face. As it happens, the example of Eristalis is a good one; for the history of its confusion with the bees is a most interesting one, showing how much delusion may arise, and not only delusion, but myth, merely from the want of a little knowledge of structure.

Sammlung Schubert, XLII. Theorie der Electrizität und des Magnetismus. Vol. ii. By Prof. Dr. J. Classen. Pp. ix+251; with 53 figures. (Leipzig: G. J. Göschen'sche Verlagshandlung, 1904.) Price 7 marks.

THIS forms the second part of an introductory text-book of electricity and magnetism in which chief stress is laid on the mathematical side. In this volume the Faraday-Maxwell conception of electrical phenomena still forms the central idea; but, since the representation of simple magnetic phenomena in terms of a distribution of energy in a medium presents considerable difficulty from the mathematical standpoint, the classical conception based on action at a distance is retained, but regarded merely as a mathematical device and not as a physical conception. In the section on electromagnetism the author adopts the special form of equations developed by Hertz in his paper on the fundamental equations of electromagnetism for bodies at rest, and expresses his strong opinion in favour of generally adopting these in all treatises of mathematical physics.

Only one part of Maxwell's characteristic treatment of the subject finds no place here, and that is his demonstration of the connection between the fundamental equations of electricity and the general Lagrangian equations of mechanics.

Vegetationsbilder. By Drs. G. Karsten and H. Schenck. Third series. Parts i.–iii., containing plates i.–xviii. (Jena: Gustav Fischer, 1905.)

BOTANISTS who possess the first two series of the "Vegetationsbilder," or who have had the opportunity of admiring these magnificent series of photographic reproductions, will be glad to see that the third series is rapidly taking shape. The subject of epiphytic flower-gardens arising out of ants' nests, which formed part of a previous number, by Mr. E. Ule, is more fully treated in the first part of this series by the same authority. The ant-gardeners are species of Azteca, most often *Azteca Traili* and *Camponotus femoratus*. The plates represent different stages in the formation of the gardens; the plants which develop from seed brought in by the ants are chiefly aroids, bromeliads, and species of Gesneraceæ. In the second part Mr. E. A. Bessey presents a study of the sand-dunes, shifting and stationary, of Russian Turkestan with a vegetation of Calligonum, Salsola, Tamarix, and other xerophytes; the arboreous Salsola is particularly interesting. The photographs of Java, forming the third part, have been supplied by Prof. M. Büsgen, Mr. H. Jensen, and Dr. W. Busse. The subjects chosen include the teak forests, an expanse of the lotus, *Nelumbium speciosum*, a sand-dune bound by the creeping *Spinifex squarrosus*, and a bamboo forest.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Remarkable Coelenterata from the West Coast of Ireland.

I have been allowed to examine a small collection of Alcyonaria and Antipatharia that has been obtained by the fisheries branch of the Department of Agriculture for Ireland from deep water off the west coast of Ireland, and as this reveals some features of special interest I should be glad of an opportunity to write a short preliminary note upon it pending the examination of the species in detail.

The most interesting feature, perhaps, is the Coralliid, *Pleurocorallium johnsoni*, from 382 fathoms, about sixty miles off Achill Island. The family of precious corals to which this species belongs has hitherto only been obtained in the Mediterranean Sea, the Japanese seas, off Madeira and the Cape Verde islands, and in the Banda Sea. The specimens obtained by the *Challenger* in the Banda Sea were "dead," but I have recently published a preliminary note on a new species of precious coral from deep water off the coast of Timor, which was captured "alive" by the naturalists of the *Siboga* Expedition.

The distinction between the genus Corallium, to which *C. nobile*, the precious coral of the Mediterranean, *C. japonicum*, and *C. reginae*, the new species from Timor, belong, and the genus Pleurocorallium is not a distinction of very great importance, and, as recently pointed out by Kishinouye, cannot, with convenience, be much longer maintained. If, however, for the present we retain the two generic names it must be noted that Corallium no longer maintains its monopoly of corals that are precious, as the species *Pleurocorallium elatius* yields some of the most valuable classes of coral obtained in the Japanese fishery. Both in Japanese waters and off the Cape Verde Islands the valuable and the commercially worthless Coralliidæ occur in the same fishing area, and consequently it would not be a matter for surprise if a renewed investigation of the locality from which the Irish Fishery Department obtained its specimen of *Pleurocorallium johnsoni* yielded some specimens of commercial value.

I should not like to suggest the prospect of a coral fishery off the coast of Ireland, as the sea is too stormy and the water too deep at the station from which the specimen came to render any such fishery commercially successful, but it would be a matter of considerable scientific interest to find that precious corals are growing within a few miles of our British coasts.

The second feature of interest is the occurrence in these waters of at least three species of Antipatharia. This group of Cœlenterata is one which I thought was entirely exotic. I can find no mention of any Antipatharians in any of the lists of the British marine fauna that I have examined, but perhaps some of your readers could inform me if I have overlooked any references to them. The species are, I believe, *Cirrhipathes spiralis*, *Antipathella gracilis*, and a species which I think must be new, but is allied to *Stichopathes lütkeni* in some respects.

Among the other interesting things in the collection are representatives of the alcyonarian genera Ceratoisis, Stachyodes, and Eunephthya, which I believe are new to the British fauna. The two pennatulid genera Kophobelemnon and Umbellula were obtained in deep water off the west coast of Scotland by the *Knight Errant* (Kophobelemnon only) in 1880, and by the *Triton* in 1882. These also have now been found off the west coast of Ireland. Although these genera may now be included in the British fauna as being found within the British area as defined by the British Association committee of 1888, they really represent the fauna that is common to the "mud line" of Murray of the eastern side of the North Atlantic Ocean.

Thus Pleurocorallium occurs off the Cape Verde Islands, Stachyodes off the Azores, *Ceratoisis grayii* off the coast of Portugal, *Antipathella gracilis* off the coast of Madeira, Kophobelemnon and Umbellula off the west coast of Scotland. These genera, with many others that live with them, constitute a fauna which is quite distinct from the ordinary shallow-water fauna of the British area.

Sydney J. Hickson.

Victoria University of Manchester, October 24.

Action of Radium on Gelatin Media.

Some misapprehension appears to exist in certain quarters as to the precise nature of the bodies I have called radiobes, as distinct from such aggregations as those which M. Dubois has obtained by the action of the salts of barium, radium, and manganese upon bouillon. M. Dubois describes his bodies as "*grosses vacuolides*," and their appearance is quite different from that of the bodies I have described, judging by the drawings which have been reproduced in the *Revue des Idées* during the last few months.

I have observed two distinct types of bodies, of an entirely different order of magnitude, one type, radiobes, extremely minute and only visible with the highest powers: the other visible with an ordinary magnifying glass. The latter are decidedly crystalline in their structure, and resemble the bodies obtained in various ways by the action of salts on gelatin. They are like the ones described by Schenck, and very like those obtained by Dubois and others.

The smaller type cannot be said to be large in any sense of the word, and are like the minutest visible diplococci or biscuit-shaped cocci. They do not exceed this size to any great extent.

It is therefore desirable that the two types should not be identified, as their appearance, order of magnitude, structure and behaviour seem to be quite different.

M. Dubois has not noticed these, and therefore it seems to me that his claim to priority is quite irrelevant.

Cambridge, October 21. John Butler Burke.

Border occasionally seen between Light and Dark Regions on Photographic Prints.

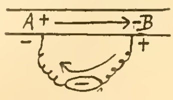
I have once or twice been asked why photographs are apt to show a line or band or edging along the boundary of a bright and dark region. My assistant, Mr. E. E. Robinson, has thought of the reason, and it may be convenient to publish it. In a developed film the exposed portion perceptibly differs in thickness from the unacted-on portion, and accordingly the linear boundary of two contrasted regions may sometimes act as a cylindrical lens, and during printing either concentrate or disperse the light on the positive immediately beneath it.

October 20. Oliver Lodge.

Terminology in Electro-physiology.

I would deem it a favour to be assigned the space of a letter in order to make a suggestion in connection with the above still vexed subject.

It cannot be said that even now all is peace in the realm of electrical terminology as applied to physiological phenomena, in spite of Dr. Waller's helpful efforts in this direction. Dr. Waller's term "zincative" admirably expresses that a given region (A) of excited tissue is "electromotive like the zinc of a voltaic couple,"[1] is, in fact, a source of current towards a region (B) of less excited or non-excited tissue (the current, of course, travelling in the tissue from the region A to the region B, and in the external circuit from the region B to the region A); but it leaves untouched the solution of the old muddle over the use of the signs + and −.



Confessedly, "zincative" avoids any reference to + and −, but every teacher of physiology knows that sooner or later the + and − must appear, and with them all the ambiguities of "negativity of action," &c., if the student is to make his notes "agree" with his text-book.

[1] "The Signs of Life from their Electrical Aspect," p. 17. (Murray, 1903

A large part of the difficulty arises from the different points of view taken by the electrician and the physiologist respectively, the electrician being concerned chiefly with the surfaces of conductors, the physiologist being interested chiefly in the interiors of living tissues.

Thus the above expression, "region A," is electrically ambiguous, for it may mean (1) either the *surface* of the region A, or (2) the *interior* of the same: certainly physiologically (and it may be also electrically) these are two very different things.

Are we speaking of surfaces or interiors when we talk of tissues and their electromotive states? This seems to me the gist of the initial obscurity.

In Dr. Waller's terminology A is "zincative" to B; but the electrically-minded student wishes to distribute his + and − somehow. The electrician says A is "negative" to B, because he is thinking of the surface at A to which current has been coming from B, as he finds by the galvanometer; but the physiologist, conceiving of what is going on *inside* the excited portion of tissue A, says, or should say, "A is electropositive to B," because he finds that current in the tissue must have come from A to B. The ambiguity is bound up with not distinguishing the surface from the interior.

All doubt, it seems to me, is removed when we say, the region A is, as to its interior, electropositive to B, but as to its surface electronegative to B; as to its *interior*, A is a "*positive plate*," as to its *surface* a "negative pole." Both these ideas are necessarily connoted by "zincative," only implicitly, however; for teaching purposes they must be made also explicit.

"Negativity of action" is then intelligible when it is distinctly laid down that it is only the *surface* of the active region that is being considered, for if the interior of the active tissue is thought of, then positivity of action must be the term descriptive of the electrical state.

If, then, the qualifying term "internally" or "externally," as the case requires, be added, no loophole for confusion is left; thus, A is internally electropositive to B, externally electronegative to B; B is internally electronegative to A, externally electropositive to A; for "externally," "galvanometrically" may be used.

Personally I think the use of the term "negativity of action" is, especially if used in teaching, objectionable, because misleading and mysterious; "internal positivity of action" certainly seems to describe a real state; as terms, the one is but the converse of the other. I have, however, no more sympathy with those people who persist in finding "negativity of action" entirely meaningless than I have with those who will not understand "negative pressure" or negative quantities of any kind.

DAVID FRASER HARRIS.

Physiological Department, University, St. Andrews, October 31.

The Engineer's Unit of Force.

IN a review of some recent works on mechanics in your issue of October 19, the reviewer calls to account two of the authors whose books are reviewed for "implying that the unit of force in the engineer's system is a variable quantity."

Perhaps there may be others than the authors referred to and myself who would welcome more explicit enlightenment on the subject of the constancy of the engineer's unit of force.

D. J. CARNEGIE.

October 23.

THE engineer's unit of force is equal to the earth's present attraction on the standard pound mass at a specified place, viz., for this country, *London*. Its magnitude is such that it produces unit acceleration when acting on a mass of 32·182 . . lb., the engineer's unit of mass, sometimes called a slugg (sluggish). The formula $M = W/g$, where M is the mass in sluggs, is true for any latitude, g being the acceleration of gravity there, and W the weight of the mass in pounds force, as would, for instance, be registered at the place by a massless spring balance which had been graduated in London. If the pound-poundal system of units is an absolute dynamical one, so also is the pound-slugg or engineer's system.

THE REVIEWER.

PROF. LANKESTER'S "EXTINCT ANIMALS."[1]

THOSE who, like the writer, had the good fortune to be present at the Royal Institution last Christmas and listened to Prof. Lankester's course of holiday lectures to young people will recall the fact that, although a goodly space was occupied by boys and girls from school, the theatre was elsewhere crammed with "grown-ups," who were quite as much interested and amused as the juvenile audience for whom these discourses were really designed.

It is, in fact, an open secret that quite elderly young people, as much as schoolboys and girls, enjoy their "ologies" when given to them in a form easy of digestion and with as few hard words as possible.

Before the memory of those pleasant afternoon discourses has faded from our minds comes a reprint of them in book form, with reproductions of more than 200 of the illustrations given in the text as we saw them on the screen.

Every boy and girl who heard those lectures will wish for a copy of this charming book, and those who did not will now read with delight the pictured story of extinct animals for themselves; nor will the "old boys" fail to take it up also.

Prof. Lankester explains that extinct animals are those which no longer exist in a living state. Animals, of course, die daily, and men too, but the lecturer tells us of extinct *kinds* of animals which no longer exist on the surface of the globe in a living state, although once they flourished and held their own.

He then informs his young friends of his own early experiences as a boy in visiting the British Museum and being fascinated by the huge head of an Ichthyosaurus from Lyme Regis with its large and bony-plated eyes, and its jaws, more than 3 feet in length, armed with powerful teeth.

Then the huge ground-sloth from South America attracted his wonder and admiration by its vast bulk, and he learnt that living upon the leaves of trees, but being too heavy to climb, it stood on the ground and pulled the trees down to it in order to feed on the young branches.

Their remains, often with the bones of the same individual lying in one spot, occur in the vast "pampas formation" and in the alluvial mud of the great rivers such as the La Plata. Here, too, one meets with the giant armadillo, and another strange creature, called the Toxodon, like a huge guinea-pig, nearly as big as a rhinoceros, with tremendous chisel-like teeth in front.

Prof. Lankester shows the thigh-bone of a giant reptile from North America more than 6 feet long (known as Atlantosaurus). What the size of the entire animal must have been we can best judge by paying a visit to the Cromwell Road Museum to see the skeleton of the Diplodocus lately set up there, which is 80 feet long and fully 14 feet high!

Passing rapidly over such forms as the ancient rhinoceros, the northern hippopotamus, the beaver, and great auk once common in Britain, but now extinct—the author tells how zebras, quaggas, antelopes, and giraffes are being fast killed off in Africa by our sportsmen, whilst the dodo and "Steller's sea-cow" were eaten up long ago, like the giant tortoises, by our early voyagers, who victualled their ships with these rare animals.

The author next explains the causes which have brought about the migration of some animals and the extinction of others, and how changes of climate and

[1] "Extinct Animals." By E. Ray Lankester, M.A., LL.D., F.R.S. Pp. xxiv+332; with 218 illustrations. (London: Archibald Constable and Co., Ltd., 1905.) Price 7s. 6d. net.

alterations of coast-lines have modified the existing lands so much that, as in our own islands, Great Britain and Ireland were, at no remote geological time, joined to France, and a continental, instead of an insular, climate prevailed here, with hotter summers and colder winters, suited to the mammoth and reindeer which roved quite freely from land to land.

FIG. 1.—A drawing showing the probable appearance in life of Arsinoitherium (original); from the Upper Eocene of the Fayûm, Egypt. From Lankester's "Extinct Animals."

He explains what "fossils" are, and how the sedimentary deposits, in which extinct organisms occur, have been gradually laid down on the sea-floor or along coast-lines. From minor changes he illustrates those greater ones which took place long since involving whole continents, so that where London now is was formerly the sea with marine shells and fishes, aptly reminding one of Lord Tennyson's lines:—

"Oh Earth! what changes hast thou seen—
There where the great street roars
Was once the stillness of the central sea."

The story of the living and extinct elephants is well told, and we get the latest evidence of the progenitors of these very ancient prehistoric beasts, the result of Dr. Andrews's explorations and discoveries in the Fayûm, Egypt, which has carried their ancestry back to the Eocene Palæomastodon and Meritherium. Near to the elephants comes the wonderful Arsinöitherium, also from the Fayûm, with a pair of prodigious horns on the front of its skull, a form of animal which may possibly have had a short proboscis like the tapir (Fig. 1).

The birds and reptiles come in for due share of attention, and from their striking forms they add largely to the attractiveness of the illustrations. The comparison of the wings of Pterodactyle, bird and bat is most instructive, showing that reptiles, as well as mammals and birds, enjoyed the power of flight, as some also equally possess the power of swimming. Dimetrodon was undoubtedly a swimming reptile (see Fig. 2).

Fishes, Mollusca, scorpions and Crustacea, also "sea-lilies," are dealt with in these lectures, and, as might naturally be expected, these simpler forms of life made their appearance far earlier in geological times than the more highly organised creatures now living on our earth.

More surprising still is it to find that the marine king-crabs (Limulus) and the scorpions (the latter at first aquatic, and afterwards terrestrial air-breathers) which are met with in the Upper Silurian rocks in America, Scotland, and Sweden have survived all the Old World changes of land and sea, the king-crabs being still found living in the China and Indian seas and on the east coast of North America, and the scorpions have spread over the *dry lands* of North and South America, Africa, and other countries, and are so little changed in appearance—whole generations of other animals having appeared and disappeared entirely—that we might almost imagine they would go on for ever!

Although it would be quite impossible for the author or anyone else to describe so vast a number of groups of living and extinct organisms in one series of lectures and afterwards to present them in book form with more than 200 illustrations in a single volume of 350 pages, at least Prof. Lankester knows how to give, in an attractive form, a vast amount of information agreeably, and to excite the interest of the merest tyro (whether young or old) and awaken a desire in him or her to learn more. Fortunately the author is also director of the Natural History Museum, where he has abundant opportunities to add still more to our personal knowledge of extinct animals.

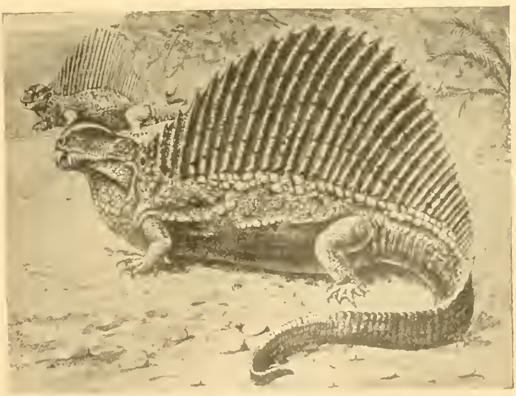


FIG. 2.—Probable appearance in life of the Theromorph Reptile, Dimetrodon, from the Permian of Texas. As big as a large dog. (It had a huge back-fin, evidently fitted for aquatic progression.) From Lankester's "Extinct Animals."

We give the book a hearty welcome, feeling sure that its perusal will draw many young recruits to the army of naturalists and many readers to its pages.

ASTRONOMY AND METEOROLOGY IN AUSTRALIA.

A VERY important paper has been issued recently by the Government printer of Adelaide, South Australia.[1] It is a report of an Inter-State Astronomical and Meteorological Conference, convened in May last, in view of the possible transfer of the observatory departments to the Federal Government as provided for in the Commonwealth Constitution Act. The official directors of the observatory departments of the several States were invited, and there were present Sir Charles Todd, K.C.M.G., F.R.S. (Government astronomer for South Australia), who was called to the chair, Mr. H. A. Lenehan (acting Government astronomer for New South Wales), Mr. W. E. Cooke (Government astronomer for Western Australia), Mr. P. Baracchi (Government astronomer for Victoria), Mr. A. A. Spowers (chief surveyor for Queensland), and Mr. H. C. Kingsmill (Government meteorologist for Tasmania).

The report represents briefly, in the first place, the present arrangements for public astronomical and meteorological work in the several colonies and the provision for weather telegrams. It then proceeds to give its proposals for the future in twenty-two resolutions. Six of them refer to work in astronomy, magnetism, or seismology; the remaining sixteen indicate a scheme of organisation of the meteorological service of the Commonwealth. The scheme is framed on the idea of the establishment of a central federal institution for theoretical and scientific meteorology, "where the observations for the whole of Australia should be collected, discussed and published, and where all the higher problems of meteorological science may be investigated; but such institution should have nothing to do with the daily weather service and issue of forecasts." Duties connected with the latter services, according to the scheme, are to be entrusted to an official in each State; and to the regulation of those services and their relation to the telegraph service the greater number of the twenty-two recommendations are devoted.

Appendices give the separate views of Mr. Baracchi, Mr. Cooke, and Mr. Kingsmill upon some of the recommendations.

The really important matter is the proposal for a separate establishment for the discussion of meteorological observations for the whole Commonwealth. The idea will be warmly welcomed by all those who desire to see the multitudes of meteorological observations brought into the most effective relation with practical life. That such an institution should have "nothing to do with the daily weather service and issue of forecasts" should probably be understood in an administrative sense. The ultimate effect of a scientific establishment upon forecasting would be a good deal more than nothing.

The calling together of the Inter-State Conference for the business-like discussion of the organisation of astronomical and meteorological work will also be warmly applauded in this country. It is one more expression of the fact that work in astronomy and meteorology is of more than local interest and importance. While doubtless real progress in either must still depend upon individual energy and individual genius, exchange of material has become a recognised necessity, and exchange of ideas an indispensable assistance.

It is therefore a pleasant duty to chronicle the appearance of this most promising scheme, which will put the Australian Commonwealth in a position to continue the excellent work of Russell and take its share in tracing out the mysteries of the meteorology of the Indian Ocean. When we remember the powerful appeal of Sir J. Eliot at Cambridge for the cooperation of the British dominions in working out meteorological problems of the widest application the solution of which is foreshadowed by the suggestions of relationship between meteorological phenomena in different parts of the world and of their connection with solar changes, we can only hope that this proposal for the federation of Australia for scientific prosecution of meteorological work is a step in the direction of a wider federation for a similar purpose.

On this planet, north and south and east and west are not so far apart that we in this country or our comrades in America or Africa can affect to regard the meteorological organisation of Australia as a question which does not concern us, and we shall watch the development of the scheme which is put forward, confident in its power of contributing in large measure to the pursuit of a common purpose in an organised manner.

W. N. S.

[1] Report of Inter-State Astronomical and Meteorological Conference, Adelaide, May, 1905 (By Authority, C. E. Bristow, Government Printer.)

FERDINAND BARON VON RICHTHOFEN.

THE unlooked-for death of this distinguished man of science has sent a thrill of deep regret all over the world among those who take interest in the progress of geology and geography. Though he had passed the limit of three-score years and ten, he remained up to the last so active in mind and body, so full of an almost youthful interest in the advances of science, so keenly solicitous and enthusiastic over the welfare of the institutions with which he was connected, that all who knew him looked forward to still many years during which his inspiration and guidance would continue to be at the service of those departments of investigation which have long been so deeply indebted to him; but this augury proved vain. While sitting at his writing table, apparently in his ordinary health, a sudden seizure deprived him of speech. Yet, as he remained otherwise fully conscious, it was hoped that the symptoms might soon pass away. A little later, however, another seizure attacked him during a deep sleep, and after two days and a half he passed peacefully away on October 6, without illness or suffering of any kind.

Belonging to a noble family that possesses large estates in Silesia, Richthofen was born there on May 5, 1833. His early education was received at a seminary under the management of Roman Catholic ecclesiastics, from which he passed to the University of Breslau and then to that of Berlin, where he took his degree of Doctor in Philosophy in 1856. By this time a study of the writings of Leopold von Buch and Alexander von Humboldt had kindled in him a vivid appreciation of the attractions of geological and geographical research. Like the two great masters from whom he drew his inspiration, he appears to have begun his career as an author by publishing some of the results of his investigation of eruptive rocks. His earliest papers, which began in 1856, dealt with the intrusive melaphyres of Moravia and the trachytes of Hungary.

Repairing to Vienna, he made the acquaintance of the geologists of that capital, and notably of the eminent director of the Austrian Geological Survey, Ritter von Hauer, with whom he formed a lasting friendship. He was induced to become a volunteer in this survey and to assist in working out the complicated structure of parts of the eastern Alps. He spent two busy seasons among the Dolomite Mountains, which in after years he looked back upon as one of the happiest periods of his life. The results of these field-surveys were embodied by him in his

essay on the Dolomite region, which was a remarkable production for so young a man.

In the midst of his Alpine work he was offered a post as geologist on a Prussian expedition to Japan, China, Siam, and the adjacent regions. The opportunity of foreign travel and exploration was too tempting to be resisted. Quitting his Austrian labours he sailed for the East, and during the next two or three years, from 1860 onwards, contributed to the scientific journals various papers descriptive of some of the tracts which he visited. Owing to circumstances which prevented him at the time from undertaking exploration in the heart of Asia, he crossed the Pacific and spent several years in western North America, where he specially devoted himself to a detailed study of the igneous rocks of that marvellously volcanic region. It was there that he prepared his now classic memoir on the "Principles of the Natural System of Volcanic Rocks," which was published in English among the memoirs of the California Academy of Sciences. This sojourn in America enabled him, moreover, to obtain a mastery of the English language, such as few foreign men of science could equal.

The opportunity of returning to Asia came at last in the autumn of the year 1868, and he eagerly availed himself of it. He spent some years in travelling over most of the provinces of the vast empire of China, studying their physical features and geological structure, and forming an extensive collection of their rocks and fossils. So voluminous were the data which he gathered together that they filled a series of massive volumes, of which the first appeared in 1877, and the Atlas in 1885. This work placed him in the front rank of scientific pioneers. It not merely made known for the first time the physical geography and geology of a vast territory, but presented contributions of great value towards the elucidation of disputed problems in science.

Richthofen's reputation as a travelled and accomplished geographer had now spread so widely that in the year 1875 he was offered, and accepted, the chair of geography in the University of Bonn, where he spent eight happy and fruitful years, and where he married the accomplished lady to whom he had been long attached. From Bonn he was called to occupy a similar position at Leipzig, whence, after only three years, he was invited to become professor of geography in the University of Berlin. In the metropolis of the German Empire he found ample scope for his rare faculties of exposition and organisation. Besides the ordinary duties of his professorship, he instituted meetings of various kinds for promoting the cultivation of geographical and geological studies, and amassed a wonderful collection of books, maps, instruments, models, and other illustrations of the physical features of the earth's surface. His enthusiasm in these efforts was rewarded three years ago by his appointment as director of the new geographical institute in Berlin, where he had ample space to arrange and display the remarkable mass of material which he had gathered together with the view of bringing home to the mind and eye the characteristic aspects of land and sea and the history of exploration and discovery in oceanography.

Baron von Richthofen was a geographer of the highest type. To him the mere addition of so many hundred square miles of territory to what was already known of the earth's surface, and the opportunity of affixing the names of friends and benefactors to peaks and promontories and inlets, were matters of comparatively little moment. It was the grand features of land and sea that interested him, their origin, their history, their relations to each other, their influence on the progress and destiny of mankind. His early geological training eminently fitted him for investigating these problems on the ground, and kept him from making the mistakes which attention restricted to mere superficial features has so often produced. He possessed in rare measure the qualities which ensure the success of an explorer—health and strength, alike of body and mind, a wide range of natural knowledge, courage, patience, endurance, tact, and kindliness. It may have been the consciousness of the possession of these qualities, combined with a recollection of the pleasure which their exercise had given him in his varied wanderings in Europe, Asia, and America, that led him to write, in the midst of his university and other work, his admirable "Führer für Forschungsreisende," which was published in 1886. No one but a born and trained explorer, who had enjoyed ample experience by flood and fell, all over the globe, could have given to the world such a volume, so full of the ripest practical knowledge, so broad in its conception of what exploration should be, and so clear and emphatic in its statement of the accomplishments which are needed for the making of a successful traveller. Every department of observation is luminously presented in his chapters, which may be regarded as a contribution of the first importance to physical geography and geology. The volume is one which ought to be put into the hands of every man who proposes to undertake the examination of new or little known regions, and who is willing to learn beforehand what is expected of him by those most competent to judge.

With Berlin as his headquarters, and a home there which attracted men from all lands, the Baron and his gracious and devoted wife formed the centre of a large circle of friends; but he journeyed far to attend meetings and congresses, where his handsome presence and genial talk were always welcomed. Hence not many men of science of his day were more widely known personally than he. He received endless marks of appreciation from learned societies and academies, both in the Old and in the New World. Our own Royal Society honoured itself by including him in its list of foreign members. His death has left a blank in scientific society which no living man is competent to fill. For many a year he will be regretted by all who even only slightly knew him, and mourned by those who were privileged to enjoy his friendship.

A. G.

THE TREASURY AND MEN OF SCIENCE.

The subjoined letter from the Earl of Crawford appeared in Monday's *Times*. The parsimony of the Government in everything relating to the scientific work needed for the State service is well known; what is not yet known generally is how much the administration is weakened by the entire absence of science, and therefore of the scientific spirit, in the higher ranks of the Civil Service, and especially of the Treasury. The official action described by Lord Crawford is another indication of the inability of the official mind to understand that science has any place in the nation's activities.

To the Editor of the "Times."

Sir,—The death, noted by you to-day, of my dear friend and colleague Dr. Copeland, His Majesty's Astronomer for Scotland, creates a vacancy in the scientific staff of Great Britain.

Will you permit me, Sir, to offer a word of warning to any who may be asked to succeed him?

Students or masters of astronomy are not, in the

selfish sense, business men, nor are they as a general rule overburdened with this world's goods. It behoves them henceforth to take more care as to their future in case of illness or physical infirmity, and not to trust to the gratitude or generous impulse of the Treasury Department.

In old days it was the custom when a man distinguished in science was brought into a high position in the Civil Service that he was credited with a certain number of years' service ranking for pension. This practice has been done away with and a bargain system substituted. A short while ago the growing agonies of heart disease caused Dr. Copeland to feel that he was less able to carry on the duties of his post, and he determined to resign; but he learnt that under the scale, and in the absence of any special bargain, the pension he would receive would not suffice for the necessities of life. The only increase his friends were able to get from the Treasury was an offer to allow him about half-a-crown a week extra by way of a house.

Indignant and ashamed of my Government I persuaded Dr. Copeland to withdraw his resignation and to retain the official position which he has honoured till his death.

I trust, Sir, that this memorandum of mine may cause eminent men of science who are asked to enter the service of the State when already of middle age to take heed for their future welfare.

I am, Sir, your obedient servant,

CRAWFORD.

2 Cavendish Square, October 28.

The number of years *given by Act of Parliament* was twenty, because the ordinary civil servant joined at twenty to learn his work, and men of science joined at about forty because they had to learn it before they were of any use to a Government department.—[ED.]

THE BRITISH SCIENCE GUILD.

THE inaugural meeting of the British Science Guild, the organisation and objects of which were stated in NATURE of October 12 (vol. lxxii. p. 585), was held at the Mansion House on Monday, October 30. The Lord Mayor presided. Among those who had accepted the Lord Mayor's invitation to attend were the following:—

The Bishop of Ripon, Lord Strathcona, Mr. Haldane, K.C., M.P., Sir Norman Lockyer, Lady Lockyer, Sir Michael Foster, Sir William Ramsay, Lady Ramsay, Sir J. F. Maurice, Sir J. Wolfe-Barry, Sir W. Bousfield, Sir G. T. C. Bartley, Sir E. W. Brabrook, Sir C. Bridge, Sir Lauder Brunton, Sir A. Geikie, Sir W. Mather, Sir H. T. Wood, Dr. G. T. Beilby, Dr. Caird, Captain Creak, Dr. Ferrier, Dr. W. Garnett (represented by his son), Mr. Gifford, Dr. Glazebrook, Prof. Gowland, Mr. R. A. Hadfield, Prof. J. Larmor, Prof. Lealey, Dr. Lockyer, Mr. C. W. Macara, Prof. Meldola, Prof. Perry, Mr. J. H. Reynolds, Dr. Shaw, Mr. A. Siemens, Mr. Swinburne, Rev. T. R. Stebbing, Mr. Carmichael Thomas, Prof. S. P. Thompson.

The following are extracts from letters expressing regret at inability to attend the meeting.

Mr. Chamberlain:—

"I am very sorry to find that I cannot possibly be in London on Monday the 30th inst. . . . I very much regret that I cannot take an active part in the meeting on this occasion, but possibly some more convenient opportunity for showing my interest may occur at a later time."

Lord Roberts:

"I am very sorry to refuse the request contained in your letter of the 12th instant, but I have so much on hand at present that I could not manage to attend. . . . I recognise the value of the Guild and wish I could help it."

Lord Rayleigh:—

"I fear I shall not be able to come to the meeting . . . but I shall be very pleased to join in the movement and become a vice-president if desired."

The following report of the meeting is reproduced, in great part, from Tuesday's *Times*:—

The Lord Mayor in a few words welcomed those who had accepted invitations to be present, and called upon Sir Norman Lockyer to read the report of the organising committee.

Sir Norman Lockyer, having read the report, said that the organising committee was grateful for the consent the Lord Mayor so readily accorded to them to hold their first meeting at the Mansion House. He had every hope that under such auspices the guild might do for British national endeavour in the future what so many ancient guilds, each in its special line of action, were founded to do in the long past. When his own views as to the importance, nay the burning necessity, of such a movement as that throughout the land, among all classes, and in touch with all employments, were expressed some time ago, he suggested that it might be brought about by extending the functions of some existing organisation, such, for instance, as the British Association; but he was soon made to see that that was to take a too narrow view of the matter. It was not a question merely of science and scientific men; it was a question of conducting all our national activ'ties, State service, private service, and what not, under the best possible conditions with the greatest amount of brain-power. To show that it was not a question only for scientific men, he would just refer for a moment to the matter of education. He yielded to none in respect for those studies which embraced ancient civilisations and their literatures, but they alone were as incapable of forming the complete man as would be instruction in the mere facts of science apart from the actual use of the methods of observation and discovery. A complete education must be based upon things and thinking, as well as upon words and memory. We wanted one kind of education for everybody—the best. We wanted that education carried as far as possible in the case of each individual, whether the time for education was long or short. No one should be stopped, save by his own incapacity, from proceeding further down the fair stream of education which should make the complete man, both educationally and physically. We want that stream freed from the impediments with which it was at present dammed—they might spell the word as they liked. These impediments were many of them needlessly hurtful, and most of them unnecessary from a large point of view.

Indeed, they wanted to revert to the ideal of the ancient university, from the curriculum of which *natura rerum* was never absent, and in which the poor student was always cared for. The western world was wondering at the efficiency of both the navy and the army of Japan. There was really nothing to wonder at. Most of the reasons suggested for what had happened were, he held, entirely wrong. If the Japanese religion or the old Japanese civilisation had been in question, then China would have followed suit. What really had happened in Japan was that for the last thirty years everybody, from the Mikado to the smallest boy and girl, had been taught to think. They had been dealing with things as well as words in their schools, and they represented at the present moment the *maximum* of efficiency and brain-power as the result of that treatment. Mr. Chamberlain, Lord Rosebery, and others had referred to the great relative advance of the commerce and industry of Germany and the United States. He would again point out that these were examples of lands with complete and numerous State-aided universities. Surely it was more than a coincidence when we found in those lands the State service and all the national activities carried on in the full light of modern science by men who had received a complete training. If the guild helped us in any way to improve our national position in this respect it would not have been founded in vain, but there was certainly much for it to do along many lines.

The Bishop of Ripon moved the first resolution:—

"That the Right Hon. R. B. Haldane be elected president of the British Science Guild." He said they had met together to enforce as far as they could what had fallen from Sir Norman Lockyer's lips. He supposed that all of them who had reflected would realise that the time had come in which it was desirable that an organisation specifically directed to that end should take its place among the useful institutions and associations of this country. He was quite sure that those who had thought hitherto of the somewhat aimless way in which the benevolent had gone about their work and the somewhat haphazard way in which, indeed, some of the industrious had pursued theirs, must realise that those ways were not likely to conduce to the general welfare, or even to conduce to the very object which the benevolent and the industrious had in view. He knew there were some who still looked askance at the words science and scientific method, and they had a sort of dim idea that science and scientific methods had come to destroy some of the most beautiful instincts of our nature. They were inclined to say to people that the new fangled notions had come in to incommode them in their activities, to destroy their cherished notions, and to check their benevolent intentions. But that was to misunderstand, as he took it, the whole situation. No person, however devoted he might be to the cause of science and scientific method, believed for a moment that science would be able to create faith or to create charity. They might, however, do a great deal to give confidence to faith, and certainly might guide the feet of charity into the ways and methods of wisdom. The value of applying science and scientific methods to all forms of human endeavour lay in the simple fact that there was the educating power which charity and benevolent impulse so generally and so legitimately desired. Everyone desired to help the needy; but who did not know that the methods of indiscriminate charity had really ended in defeating the ends which the charitable had in view? But the scientific study of economic conditions was capable of putting into the hands of the charitable the proper method of dealing with the needy. He could only recall to their minds what an eminent Frenchman said in speaking of France after the war. He said, speaking of his fellow-countrymen and of the subject which had occupied Sir Norman Lockyer's mind that day—namely, the subject of general and specific education from a national standpoint—that they had been defeated, not by Bismarck and Moltke alone, but by Kant and Hegel, Goethe and Schiller and Humboldt, and other great minds which Germany had produced. They had been defeated, in fact, he said, by the brain—the educated brain and the scientific method of those who contended against them. It was not the victory of arms alone, but the victory of brain brought to bear upon the field of war. He could imagine two classes of men becoming strongly and earnestly interested in this endeavour. He could understand the benevolent saying, "Teach us how to do good," and he could understand those who were interested in the prosperity of the nation saying, "Teach us how best to procure it." The benevolent mind was constantly brought into anxiety and suspense by questions of solicitude concerning the safety and the health of our fellow creatures, but here was a simple method by which science might come and say to the benevolent, "We are helping you to prepare the way." Let him direct their attention to two great institutions which existed, one in Holland and the other in Germany. There were two museums, called Museums of Safety, the purpose of which was to show in working models every appliance which had been devised by the care and the study of scientific men and experts for the protection of life and limb, for the promotion of health, for preventing the accident in the mine, the accident in the mill, the danger to health arising from noxious vapours in some of our great places of employment, and the accumulated dust which gets into the lungs of the worker. These and other important matters affecting the safety and the welfare of the people were dealt with in these museums. People were taught the best method of feeding their children by showing them what might be called the various values, the health values, of foodstuffs. They were shown also in economical fashion how a house might be built. These museums existed, and, with their working models, were open five days in the week for the inspection and instruction of the public. What were those great Museums of Safety which they found in Charlottenburg and Amsterdam but living witnesses of how scientific methods might be brought to bear on the protection of the health and life of the people of the world? Our manufacturers, and perhaps our farmers, had been content to go on in what might be called jogtrot ways, not watching how far knowledge had advanced beyond them, and the mere rule of thumb and the traditional methods had prevailed sometimes to the detriment of industry, often to that of the consumer. Those things were precisely the way in which that Science Guild might come forward and do what had been done in Germany, so that there might be places where the manufacturer and farmer might go and get scientific advice of the best character. Those were things which meant the one thing for which the guild had come into existence—namely, the application of scientific methods to human endeavours throughout the world. Precisely because the pressure of the competition of the world had become so great it was for us to say that the old England that we loved and were proud of should hold her place among the nations of the world, and as she had the courageous heart and the enthusiastic spirit so also she should be given the clear-thinking brain and the well-studied handicraft and industry. The urgency of the thing was clear, and the only way in which it could be applied was clear also. He concluded by proposing Mr. Haldane as president, and spoke of him as one who knew what was necessary for the public good, and essential for its industrial prosperity, and who added to that the weight of his name and the strong position which he held in the legal and political world.

Lord Strathcona seconded the motion. In doing so he said that it must be a great relief and satisfaction to all of them to find that they had placed before them something which savoured in no sense of party politics—an object which was for the general good.

Sir W. Mather supported the motion. He said that in this country we had the foundations for the highest scientific industry the world possessed. We had in many of our industries the most brilliant scientific methods and processes. We had plenty of science in England; we knew what the Germans knew, and what the Americans knew. The trouble was that the people of England had not been trained to enable them to use largely the methods of science and the principles of science which the people of other countries—not the select men, not the men specially gifted, not the men of genius only, but the men who had the conduct, even in subordinate positions, of some of the departments of scientific manufacture—possessed. The association had for one of its objects the promotion of scientific education throughout the Empire by encouraging the universities and other institutions, where the bounds of science were extended, or new applications of science were devised. What men like himself looked for in adopting scientific methods generally throughout their workshops was the foreman class, the subordinate managers, the managers who could carry out the advance of science which emanated from the top. He had just returned to England after four months' absence in the United States, and he found, while in America, that the whole tendency and trend of American thought and feeling was to take masses of their young men and train them, so that they might take their part not as managers, employers, capitalists, and so on, but as workers in their industries. That society had before it its greatest work in looking to the education of the people of England. It should work upon the Government of the day, Liberal or Conservative, and take care that there should be sufficient expenditure and sufficient convenience provided throughout the length and breadth of the land to enable our young people to have some opportunities in their lives like those which were afforded to the young people of the United States.

The resolution was carried unanimously.

Mr. Haldane, who was received with cheers, said he gratefully acknowledged that resolution and the honour which they had conferred upon him in electing him president of that new organisation. He did not know

that he had other qualifications for it than this—that the matter was one which interested him intensely. Nearly ten years ago, when the political party to which he belonged went out of office, he looked about for something to do, and he thought he might as well turn his hand to the somewhat cobwebbed state of the higher education of this country. After a time he approached the Government, and he found them sympathetic, and they had remained throughout that period sympathetic. There were those who said that some time or other they would go out and another Government come in. He hoped in the same way to have a chance of approaching that Government and trying to persuade it to be sympathetic. Why was it that so many people had come together that day—people of different minds but converging upon the same idea—to call for an activity which should be unhasting and unresting, the organisation of the higher science in its application to the affairs of this country? He thought it was because almost every year in an increasing fashion brought us in this nation an awakening. We were not the only nation which had received an awakening. Japan wakened up the nations of the West from their dogmatic slumber not long since, and we had perhaps not even yet assimilated the lesson which that awakening had taught the world. He agreed with Sir Norman Lockyer that that organisation ought not to mean merely science. It ought not to mean merely instruction; it ought to mean the bringing of method, the bringing of thinking, into the modes of government which applied to our public affairs and which applied to our private industries alike. That was what we wanted, and without that we should fall behind, and that kind of organisation meant science, and it meant education. The Bishop of Ripon alluded to the question of the Poor Law. There was a very interesting pamphlet which was published the other day, and which he commended to all of them who had not read it—the report of the Birmingham brass-workers on what they found when they went to Berlin to compare the condition of the working men of their own trade with that of similar working men in the German capital. One thing which they discovered was that in Germany the unemployed question had been to a great extent solved. There were two ways in which they could deal with the unemployed question without solving it. One was to do nothing at all, but say that so-called economic laws must work their way. That view, he thought, opinion nowadays condemned. But there was another way which he hoped the nation would condemn just as severely, and that was to grant public money in response to any demand which was made by ignorant people without recognising the fact that steps of that kind merely meant that one got a body of honest but weak people who came to depend, not on their own exertions, but on what the State would do for them. The brass-workers found organisation. They found that science had been set to work to solve the problem of the unemployed. They found that the unemployed were sifted out by State, municipal, and private charitable organisations directed and employed by the State. They were sifted into classes. Those who wanted work and could not get it were provided for to almost a complete extent by the cooperation of the Government and the employers and the municipalities. Those who had not got work and did not want it were put into places which were not prisons, but where they were forced to work for a very moderate wage, which was saved up for them and given to them afterwards. The Birmingham brass-workers came back with the view that the provision for the German brass-worker was superior to anything even in Birmingham. They were too enthusiastic. He had lived in Germany, and he knew that the things they saw there would never be tolerated in this country. From the cradle to the grave the German was ruled. Paternal government was exercised over him, well aided by what he might, figuratively speaking, call the birch rod. At no point of his existence was he a free man, and the result was that in Germany to-day there was something like a revolt, and an aspiration for our British freedom. A pamphlet had been published on the Germans and their Fatherland, in which a plea was put forward for the study and imitation of English institutions. It had had an immense circulation in Germany, and ought to be translated into English. The writer advised his readers to go to see Eton and Harrow, where there might not be much learning, but where the boys ruled the school, set up public opinion among themselves, and as a result turned out governors of men and patriots, instead of men who, like the Germans, when they left their country felt in the recollection of their schools that they had left an almost prison life. That great German authority was under the same delusion as the Birmingham brass-workers. He was too enthusiastic. But in that pamphlet the German Emperor was quoted as making the observation that the real truth about the matter lay between the German and the British systems. We had to see how we could get the German faculty of organisation, train people to think more of it, and apply it to the various departments of our affairs. Our executive Government was about as disorganised an institution as anybody could conceive. Suppose they wanted to appoint a man of high scientific mind as an official. They were at once told that it would be against the rules of the department. In vain they would reply they were bringing in a man of science for public purposes; the answer would be that the Civil Service rules made it difficult to do anything of the kind. Some of them had been trying to impress upon the nation that the organisation of the highest education of the universities ought not to be left to haphazard. He was chairman of a committee which sat last year, and they made a report which had been more lucky than most reports. One of its recommendations related to the grants to the university colleges of this country, and was that a scientific advisory body should be created and put at the elbow of the Treasury to advise it in giving money to the universities. He was glad to say that a sympathetic Chancellor of the Exchequer had adopted that suggestion, and in the course of the winter they would learn who the advisory members were to be. Let them take another department —the Board of Trade. The Board of Trade ought to be a great ministry of commerce. We had a vast home trade as well as a vast foreign trade, and the statistics relating to them should be of the most authoritative kind. There was the same necessity for scientific methods in relation to the Home Office and the departments with which it dealt. For himself he believed that things would not be right until we had a scientific corps under a permanent committee, just as the Defence Committee was under the Prime Minister to-day. He meant a body that would not consist merely of officials of the ordinary kind, but should consist of the most eminent men of science, who would go there because they were honoured and put on the footing upon which they deserved to be placed, and were recognised as a body of men who would be at the elbow of the department, and could organise the scientific work of the State. He hoped that if they got to that, the example of a Government adopting science would be followed by the municipalities, as he believed it was going to be followed more and more by our manufacturers. There was great work for that association to do. We lived in a country where science was not so much appreciated as it should be. Our people liked to see cash over the counter, and they did not like to wait for deferred payment. But we were waking up, and we had this enormous advantage, that our very individualism had produced some of the finest scientific talent of the world. He did not like to mention men on that platform, though he could do so, whose names ranked with the highest of the world. We had produced, to speak of those who were absent, our Kelvins, our Rayleighs, our J. J. Thomsons, than whom the world had no greater, to say the least of it. He had no doubt that if the British nation were given a chance it could beat the world. But we wanted knowledge. This was a new century; we had a new Sovereign; we might have a new Parliament; we should have a new chance. Let us see to it that we used our opportunities. The midnight call had come, let us take heed that we were ready. Knowledge was power. That was the great lesson of to-day. Let us hold to it that knowledge was power, and that without knowledge there was no real power in these times of intense competition.

Mr. C. W. Macara (president of the Federation of Master Cotton Spinners' Associations) moved:—"That

those whose names are given in the provisional list as vice-presidents and officers of the British Science Guild be elected in those capacities and asked to serve."

This list is as follows:—

Vice-presidents: The Right Hon. the Lord Mayor of London, Sir Lawrence Alma-Tadema, O.M., R.A., the Right Hon. Lord Alverstone, G.C.M.G., F.R.S., Lord Balcarres, M.P., the Right Hon. the Earl of Berkeley, Admiral Sir Cyprian Bridge, G.C.B., Sir William Broadbent, Bart., K.C.V.O., F.R.S., Sir Walter Buller, K.C.M.G., F.R.S., Sir J. Burdon-Sanderson, Bart., F.R.S., Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., the Right Hon. Joseph Chamberlain, M.P., F.R.S., Sir William Church, Bart., K.C.B., Sir George Sydenham Clarke, K.C.M.G., F.R.S., Sir John Colomb, K.C.M.G., M.P., the Right Hon. the Earl of Donoughmore, the Right Hon. Earl Egerton of Tatton, Sir John Eliot, K.C.I.E., F.R.S., Sir Michael Foster, K.C.B., M.P., F.R.S., the Right Hon. Sir Edward Fry, F.R.S., Sir Archibald Geikie, F.R.S., Mr. F. Du Cane Godman, F.R.S., the Right Hon. Sir John Gorst, K.C., M.P., F.R.S., the Right Hon. Lord Haliburton, G.C.B., Sir Joseph Hooker, G.C.S.I., F.R.S., Sir Alfred Jones, K.C.M.G., the Right Hon. Viscount Knutsford, G.C.M.G., Prof. Ray Lankester, F.R.S., Dr. J. Larmor, F.R.S., Mr. C. W. Macara (president of Federation of Master Cotton Spinners' Associations), Sir Charles McLaren, Bart., K.C., M.P., the Right Hon. Sir Horace Plunkett, K.C.V.O., F.R.S., the Right Hon. Lord Rayleigh, O.M., F.R.S., Prof. Rhys, the Lord Bishop of Ripon, Mr. E. Robertson, K.C., M.P., the Right Hon. Lord Tennyson, P.C., G.C.M.G., Sir Philip Watts, K.C.B., F.R.S., His Grace the Duke of Wellington, K.G., G.C.V.O., Sir John Wolfe-Barry, K.C.B., F.R.S.; *chairman of committees:* Sir Norman Lockyer, K.C.B., F.R.S.; *vice-chairmen:* Sir William Abney, K.C.B., F.R.S., Sir Lauder Brunton, F.R.S., the Right Hon. Sir John Cockburn, K.C.M.G., Sir Gilbert Parker, M.P.; *trustees:* the Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., Sir Henry Roscoe, F.R.S.; *hon. treasurer:* the Right Hon. Lord Avebury, F.R.S.; *hon. assist. treasurer:* Lady Lockyer, 16 Penywern Road, S.W.; *hon. secretary:* Mr. C. Cuthbertson, *pro tem.*

Admiral Sir Cyprian Bridge seconded the motion. In doing so he said that the officers of the Japanese navy had frequently mentioned to him the satisfaction it was to them, and the benefit it had been to them, to have been brought up by officers of the British Navy.

The resolution was agreed to.

Sir J. Wolfe Barry moved:—"That the president, vice-presidents, and officers and the other members of the Guild mentioned in the provisional list be elected members of the general committee of the Guild." He said that the movement must be looked upon as an educational movement, to educate the people at large and the Government and political parties not to undervalue the great resources of science in the development of the kingdom. Much had been done, and he had only to look back on the progress of the nineteenth century to see how leading a part science had taken in the development of the nation. But everybody must admit that we must not rest and be thankful for what had been done. An immense amount remained. This country must not stand still. It had the most vigorous competitors, who brought all the product of science into the contest which they waged against us in so many industrial and social ways. The business of that guild would be, he thought, to urge everybody to go forward in hope, and we must not suffer ourselves to be left behind by the development of other nations from whom we might learn much. At the same time, he firmly believed that this country had nothing to fear if only it were true to itself.

Major-General Sir J. F. Maurice seconded the resolution, which was passed.

Sir W. Ramsay moved a vote of thanks to the Lord Mayor. In doing so he said that in England we had a great deal of scientific ability. Much of it was organised, but its application to the affairs of the State, to the Army, to the Navy, to the service of the nation at large, could be very much better organised than it was. The object of that guild was to attempt to effect that organisation, which was so much required. If that was so he was sure they would all agree that to promote the object of that guild was one of the most important tasks which the nation could undertake. He hoped they would all unite to promote that object and gain adherents for the guild, with the result that before many years we should be less of a disorganised rabble and more of an organised army than we were now.

Dr. Robert Caird seconded the motion, which was heartily carried.

NOTES.

We regret to announce that Prof. Ralph Copeland, Astronomer-Royal for Scotland and professor of astronomy in the University of Edinburgh, died on October 27, at sixty-eight years of age.

Captain F. W. Hutton, F.R.S., curator of the Canterbury Museum, Christchurch, New Zealand, and president of the New Zealand Institute, died on October 27 while returning home by the R.M.S. *Rimutaka* at the conclusion of a visit to England. He was sixty-eight years of age, and was elected a Fellow of the Royal Society in 1892.

An interesting gathering of the old pupils of Mr. Francis Darwin, F.R.S., formerly reader in botany, was held in the botany school of the University of Cambridge on October 28, when his portrait, by Mr. W. Rothenstein, was presented to the botanical department by a body of subscribers, all formerly his pupils. To Mr. Darwin himself was presented a handsome book containing autographs of his pupils. Speeches were made by members of the staff and by other botanists regretting the severance, after twenty-one years, of Mr. Darwin's connection with the botanical department.

At a meeting of the general committee of the British Association held on Tuesday, Leicester was adopted as the place of meeting of the association in 1907 by the following resolution, which was passed unanimously:—"That having regard to the fact that no meeting of the Association has as yet been held in Leicester, the general committee decides to accept the cordial invitation from that town, and at the same time expresses its most hearty appreciation of the kind and courteous invitation from the city of Dublin, and ventures to express the hope that the invitation may be renewed at an early date."

On Monday, October 30, a strong earthquake shock, lasting four seconds, was recorded at Catanzaro in the afternoon; and two earthquake shocks, one rather marked and the other slight, were observed at Monteleone in the evening.

We have received a letter from Dr. Faulds in which he replies to the review of his book on October 19 (supplement, p. iv). The more important part of his letter lies in the assertion that he *had* devised a method of classifying finger-prints. Where can an exact description of his method be found? His book contains only generalities about it, and his present letter goes no further.

At the annual general meeting of the Royal Society of Edinburgh, held on October 23, the following officers and members of council were elected:—*President,* the Right Hon. Lord Kelvin, G.C.V.O., F.R.S.; *vice-presidents,* Hon. Lord M'Laren, Prof. Flint, Dr. R. Munro, Sir John Murray, K.C.B., F.R.S., Dr. R. H. Traquair, F.R.S., Prof. Crum Brown, F.R.S.; *general secretary,* Prof. George Chrystal; *secretaries to ordinary meetings,*

Prof. D. J. Cunningham, F.R.S., Dr. C. G. Knott; *treasurer*, Mr. P. R. D. Maclagan; *curator of library and museum*, Dr. Alex. Buchan, F.R.S.; *councillors*, Prof. Andrew Gray, F.R.S., Dr. R. Kidston, F.R.S., Dr. D. Noël Paton, Prof. John Chiene, C.B., Prof. J. Graham Kerr, Dr. W. Peddie, Dr. L. Dobbin, Prof. J. C. Ewart, F.R.S., Dr. B. N. Peach, F.R.S., Dr. J. J. Dobbie, F.R.S., Prof. G. A. Gibson, Prof. J. P. Kuenen.

AN International Fisheries Exhibition, to include everything connected with the sea—either oceanographical or sea fisheries business—will be held at Marseilles under official control from April to October, 1906. The oceanographical part of the exhibition will illustrate the work of the principal biological societies, marine zoological laboratories, and similar institutions. The investigations of the Prince of Monaco will occupy a large room, and France, Germany, Portugal, the Netherlands, Norway, Sweden, America, Japan, and England will have separate spaces allotted to them. The practical and industrial side of fisheries in many parts of the world, as well as the products of the sea, will be represented. Applications for space will be received up to January 15, 1906, by the agents, Exposition de Marseille, 5 rue des Mathurins, Paris, who will also supply any further information required.

MAJOR-GENERAL SIR CHARLES WILSON, K.C.B., F.R.S., died on October 25 at Tunbridge Wells in his seventieth year. Trained as a soldier, his aptitude for work outside the routine of regimental duty soon led to his appointment in directions in which his scientific attainments could be utilised. In 1858, when he was but twenty-two years of age, he was appointed secretary to the North American Boundary Commission. From 1864–6 he was engaged on surveys of Jerusalem and Palestine, and for two years after this with the Ordnance Survey of Scotland, when he again left home to undertake the survey of Mount Sinai. This piece of work was followed by seven years as the director of the topographical department of the War Office. From 1876 to 1878 he was engaged on the Ordnance Survey of Ireland, and from 1886 to 1894 Sir Charles Wilson was the director-general of the Ordnance Surveys at headquarters. He was elected a Fellow of the Royal Society in 1874, and was twice president of the geographical section of the British Association, in 1874 at Belfast and in 1888 at Bath. He served as a vice-president of the Royal Geographical Society from 1897–1902. He was the author of several works on those countries in the east where his surveying work was done, in addition to one or two well known guide-books. It is interesting, in view of the attention given in recent years to the claims of geography to be included in the subjects required of army officers, to remember that Sir Charles Wilson, in his British Association address in 1874, spoke of the influence which the physical features of the earth's crust have on the course of military operations, and of the consequent importance of the study of physical geography to all those who have to plan or take part in a campaign.

A MEMORIAL bust of the late Dr. Joule was unveiled on October 28 at Sale, near Manchester. The ceremony was performed by Sir William Bailey, president of the Manchester Literary and Philosophical Society, who delivered an address. In the course of his remarks, Sir William Bailey said that Joule was born in New Bailey Street, Salford, in the year 1818. He studied under Dalton, who advised Joule's father to send him, on the completion of his studies, to Sturgeon, the inventor of the soft iron magnet. Under his instruction Joule became a competent electrician, and the inventor of electric welding. Mr. Denny Lane was at the British Association meeting at Cork in 1843 when Joule read his first paper on the "Mechanical Equivalent," and he assisted Dr. Joule to drum up an unwilling audience of six people, of which he was one. Sir William Bailey compared, in one part of his address, the coal consumption from the year 1840 to the present day. In 1840 the *Britannia*, 740 horse-power, Cunarder, used more than $4\frac{3}{4}$ lb. of coal, in 1862 the *Scotia* used $3\frac{1}{4}$ lb., in 1881 a steamboat used 2 lb., and to-day the lowest consumption is 1 lb. per horse-power per hour; much of this economy may fairly be credited to knowledge of the mechanical equivalent. There are about 13·500 British thermal units in a pound of good coal, and if there is no loss in consuming it there would be a power equal to five horses obtained from it; but engineers know that the best engines under the most scientific conditions and skilful attention with boilers under the most skilled superintendence only give a duty of 1 horse-power for 1 lb. of coal. Joule invented electric welding in 1855. With a battery of six Daniel cells he succeeded in fusing steel wires and uniting steel, brass, and platinum to iron. Again, his experiments proved that it takes $\frac{3}{4}$ lb. of zinc to fuse 1 lb. of iron. Some portion of Joule's library and apparatus is at the Manchester Technical School.

THE sixth annual Huxley lecture of the Anthropological Institute was delivered on Tuesday, October 31, by Dr. John Beddoe, F.R.S., ex-president of the institute; the chair was taken by Prof. Gowland. The lecturer chose as his subject "Colour and Race," and dealt mainly with the problems of Central Europe and the British Isles. After asserting the right of pigmentation to a high place among somatological data, Dr. Beddoe traced the history of the colour question, maintaining the correctness of his own methods as against those of Virchow and others; he showed, incidentally, that the latter gave incorrect results in certain areas. After adverting to the influence of heat, humidity, and various kinds of disease in causing selection of brunettes in certain localities, he passed on to explain in detail pigmentation maps of Central Europe which he had prepared; fairness was shown to increase from south to north, both in Europe and the British Isles, but it was open to question whether in the latter case historical rather than climatic grounds were not mainly operative. On the map of Ireland the traces of invading races were strongly marked; but in England the Saxons had not exterminated the preceding races, as was sometimes imagined. In conclusion, the lecturer asserted the probability of a change in the direction of dark pigmentation in this country, due to the predominant influence of the proletariat. The Huxley memorial medal was then presented to the lecturer by the president, and suitably acknowledged by the recipient.

IN an interesting article in the *Times* (October 28), some of the current theories on the ætiology of the disease known as "beri-beri" are reviewed. That of Dr. Hose, which ascribes the disease to the consumption of mouldy rice, is considered to accord with the facts better than any other. It must, however, be admitted that in the opinion of those best qualified to judge, this dietetic theory cannot be maintained. At the same time, it would be well, in the present state of our knowledge, to examine critically all theories, and it is stated that experiments are being made at Cambridge, under Prof. Sims Woodhead's direction, to test the truth or otherwise of Dr. Hose's theory.

AT a largely attended meeting of the Brighton and Sussex Medico-Chirurgical Society held at Brighton on October 27, Sir Frederick Treves gave an address on the Army Medical Service. He pointed out that in the South African campaign the admissions to hospital were 746 per 1000 on account of disease, and only 34 per 1000 for wounds. Our present medical department is totally inadequate, and a sufficient reserve must be created. Sir Frederick concluded by pointing out what appeared to him to be needed to make the Army Medical Service as perfect as possible. The points were:—(1) The Director-General should be the head of his department and be responsible for its efficiency and economical administration; (2) he should have direct access to the Army Council and Secretary of State; (3) he should have control of the money voted for the medical service; (4) the service remaining, as at present, "under the supervision of the Advisory Board"; (5) an efficient Army Medical Reserve should be formed; (6) the combatant officer should have some knowledge of hygiene as applied to campaigning and barrack life, and a like knowledge, of a still more elementary character, should be possessed by the private soldier; (7) the Army medical officer should be vested with such authority and provided with such *personnel* as would enable him to carry out those sanitary arrangements in the field which experience had proved to be absolutely essential to secure the *minimum* loss of life from disease.

DR. J. HUBER, of Pará, has sent us a separate copy of his paper on the formation of colonies in the ant *Atta sexdens*, from the *Biol. Centralblatt*, to which brief reference has already been made in these columns.

THE annual report of the Geological Survey of New Jersey for 1904 includes an illustrated account by Mr. C. R. Eastman of the Triassic fish-fauna of New Jersey, prefaced by a general popular dissertation on fossil fishes. This Triassic fish-fauna is singularly limited but remarkably constant throughout the eastern United States, from Virginia northwards, comprising only half a dozen generic types, of which four are severally represented only by a single species.

WE have received five numbers of the *Proceedings of the U.S. Nat. Museum*, the contents of four of which are devoted to the invertebrate faunas of America and the Philippines. New generic types of South American moths are discussed by Mr. H. G. Dyar in No. 1419, while other new forms of the same are described by Mr. W. Warren in No. 1421. A revision of North American fleas, by Mr. C. F. Baker, forms the subject of No. 1417, in which the author directs attention to the circumstance that fleas infesting rats in the tropics are more near akin to those which attack man than is the case with the rat-fleas of cooler climates, and to the bearing of this fact on the propagation of plague. Hymenoptera from the Philippines form the subject of No. 1424; while in No. 1425 Mr. W. H. Dall discusses the "Universal Conchologist" of Thomas Martyn, published in 1784, and the value of the technical names employed therein.

MUCH interesting information with regard to scientific progress in India will be found in the report of the Madras Government Museum and Connemara Public Library for 1904–5, drawn up by Mr. E. Thurston, who recently returned to his charge after a period of furlough in this country. The scheme for a systematic ethnographical survey of India, recently sanctioned by the Government, enters largely into this report, Mr. Thurston pointing out the difficulties connected with making such a survey in a country of the size of India, and referring to the somewhat unsatisfactory nature of the replies received from some of those who have undertaken to fill up papers connected with the subject. The museum is fortunate in having acquired the valuable series of prehistoric objects collected by Mr. R. B. Foote, late of the Indian Geological Survey, during his long residence in Madras. It may interest numismatists to learn that certain ancient lead coins kept in a wooden cabinet enclosed in an iron safe were found to be reduced to powder, the metal having been converted into carbonate.

WE have received separate copies of two papers by Francis Baron Nopcsa, the one from the *Geological Magazine* for July, and the other from the *Annals and Magazine of Natural History* of the same date. In the former the author describes, with a restored figure, a large portion of the skeleton of a large carnivorous dinosaur from the Oxford Clay of Oxford in the collection of Mr. J. Parker of that city. In place of referring this splendid specimen to the well known genus Megalosaurus, Baron Nopcsa considers that it indicates a genus apart, and he identifies it with Streptospondylus, typified by a few vertebræ and limb-bones in the Paris Museum from the Kimeridgian of Havre. Among other peculiarities, the Oxford dinosaur is stated to differ from Megalosaurus in possessing four (in place of three) hind-toes. It may be mentioned in this connection that Phillips, in his description of the typical species of the last named genus, expressly stated that he was uncertain whether there might not have been a fourth hind-toe. In the second paper the author gives a new interpretation of the problematical fossil Kerunia, from the Egyptian Eocene, which has been referred by one authority to a cephalopod and by a second to a hydractinian polyp. According to the author, both these authorities were to a certain degree right, for he regards Kerunia as a hydractinian in which a cephalopod took up its residence (symbiosis). The union of the two organisms was apparently so intimate that while the encrusting zoophyte undertook the construction of the shell of the mollusc, the latter controlled to a certain extent the growth of the zoophyte.

A RETURN has been published, we learn from the *Pioneer Mail*, regarding the measures adopted for the extermination of wild animals and venomous snakes during the year 1904. The total mortality among human beings reported to have been caused by wild animals was 2157, against 2749 in 1903. The most noticeable decrease occurred in Madras and the United Provinces, namely, from 438 and 404 in 1903 to 237 and 193 in 1904 respectively. In the Central Provinces (including Berar), also, there was an appreciable decrease—from 470 to 351. The destruction of human life by tigers in 1904 was smaller than in the previous year, the number being 786 against 866. As usual, the greatest mortality occurred in Bengal. The year's returns show a marked decline in the number of deaths caused by wolves—from 463 in 1903 to 244 in 1904, the decrease occurring principally in the United Provinces, where the mortality from this cause fell from 278 to 90. It is pointed out that the number of wolves destroyed in the United Provinces has fallen from more than 1200 in each of the years 1902 and 1903 to 650 in 1904; and the belief is expressed that this points to a genuine decrease in their numbers. The mortality from snake-bite rose from 21,827 to 21,880. It is reported that in the Seoul district of the Central Provinces anti-venin was used with success in two cases, and the question of introducing more generally the treatment of snake-bite by potassium permanganate is under the consideration of the local Government. The total number of snakes killed was 65,378.

DR. L. COCKAYNE contributes a short article on the far north of New Zealand to the *Young Man's Magazine* (August 1). The narrow strip of land lying north of the thirty-fifth parallel is for the most part a barren waste traversed by a few diggers of kauri gum. A belt of mangroves lines the estuary in Rangaumu Bay, and about North Cape are found the purple-flowered composite, *Cassinia amoena,* the crimson-flowered *Veronica speciosa,* and the curious leafless parasite *Cassythia paniculata.* Especially interesting is the Reinga, a rocky mass jutting out into the sea, whence, according to Maori lore, the Maori spirits took their final leap into the unseen world.

IT is interesting to find, as noted in the *Agricultural News* (September 9), that the new Barbados varieties of sugar-cane, known as B208 and B147, have yielded good results in Queensland; the latter seems to be especially hardy and proof against fungoid attacks. A remedy is suggested in connection with an unsatisfactory shipment of mangoes that the decay which is caused by fungi or bacteria acting on the bruised surface of the fruit may be in some measure prevented by immersion in a weak solution of formalin; it is said that with due precaution the formalin does not spoil even such delicate fruit as strawberries.

AT the beginning of this year an improvement was effected in the general style of the *Indian Forester,* and now, owing to the departure of two members of the controlling committee, a more permanent arrangement for a board of management, presided over by the Inspector-General of Forests, has been established. Mr. E. P. Stebbing, who continues to act as editor, discusses in the August number the *pros* and *cons* of fire protection in teak forests, and concludes with the recommendation to consider how fires can be controlled so as to yield the maximum benefit with a minimum of damage. He also furnishes the life-history of a cecidomyid fly which produces galls or pseudo-cones on *Pinus longifolia.* Mr. E. M. Hodgson presents an interesting account of the arrangements for fire protection in the Mandui range, Surat district.

IN Bulletin No. 26, Bureau of Government Laboratories, Manila, Dr. Richard Strong gives an admirable survey of the clinical and pathological significance of the *Balantidium coli,* a protozoon parasitic in man and swine, and causing diarrhœa and pseudo-dysentery.

THE contents of the *Bulletin of the Johns Hopkins Hospital* for October (xvi., No. 175) are chiefly devoted to medical subjects, but include an interesting summary of our present conceptions as to the cause of the heart beat by Mr. E. G. Martin.

THE *Journal of Anatomy and Physiology* with the October number commences its fortieth volume, and Sir William Turner, F.R.S., who has been an associate editor since its foundation, contributes a preface. The size of the page has been much enlarged, which, it is hoped, will be more advantageous for the reproduction of drawings. The number contains ten important articles and several excellent plates.

THE papers in the October number of the *Journal of Hygiene* (v., No. 4) maintain a high standard. Among others, Dr. H. S. Willson writes on a new process for the isolation of the typhoid bacillus from water by means of precipitation with alum, Mr. Crofton on anti-bacterial sera, Mr. de Korté on a sarcosporidium of a monkey, Dr. Graham-Smith on a piroplasma parasite of the mole, Dr. Nuttall on the prevalence of anopheles, Dr. Harden on the chemical action on glucose of the lactose-fermenting organisms of fæces, and Dr. Haldane on the influence of high air temperatures.

ATTENTION is directed in the *Engineering and Mining Journal,* of New York, to the remarkable developments at Mount Morgan, Queensland, whereby the mine of that name is being converted from a great gold mine into a copper mine. Diamond-drill borings have revealed large bodies of copper gold ore below the previous openings in the gold ore sufficient to warrant the erection of smelting works capable of treating 10,000 tons of ore monthly.

AT the first meeting of the autumn session of the Institution of Mechanical Engineers, an interesting paper on the manufacture of cartridge-cases for quick-firing guns, by Colonel L. Cubillo and the late Mr. A. P. Head, was submitted. The object of the paper was to describe the new plant recently completed at the Royal Spanish Arsenal at Trubia, Spain, for the manufacture of brass cartridge-cases from 3 inches to 6 inches in diameter.

A STRIKING photograph is reproduced in *Engineering* of October 27 showing the extraordinary erosive effect of the discharge from the Assouan dam. The whole of the water of the Nile passes through sluices in the face of the dam. These sluices are at different heights, so that water is never discharged under a head of more than 29·5 feet, which limits the velocity of discharge to less than 35 feet per second. Even at this velocity, however, the water has proved capable of lifting a boulder, weighing more than 60 tons, out of its natural bed in apparently solid rock, and hurling it back against the dam.

THE following method, requiring only a scale and a pair of dividers, for the measurement of angles is given in the *Engineer.* Suppose the length of an arc of 90° to be 90 mm., the length of the radius of the corresponding arch will be $180/\pi = 57{\cdot}3$ mm. Every millimetre, therefore, measured as an arc struck with this radius corresponds to an angle of 1°. For example, if an angle of 33° is required, describe an arc of 57·3 mm. radius and mark off upon it with a pair of dividers 10 mm. three times, and finally 3 mm. for the odd 3°. The method is equally applicable to British measures if the standard radius is taken at 5·73 inches, when the degree corresponds to one-tenth of an inch.

THE October issue of the *Journal of the Franklin Institute,* of Philadelphia, contains an account of the invention and development of the telautograph. Electric transmission of handwriting has received attention ever since telegraphic transmission of printed characters was effected. Prof. Elisha Gray exhibited a telautograph at Chicago in 1893, but cost and difficulty of manufacture led to its abandonment. The instrument has been brought to its present state chiefly through the experimental work of Mr. G. S. Tiffany. It is a variable current instrument with several interesting features, including what may be termed a straight line D'Arsonval movement, which is used to work the receiver. A large number of private line telautographs are now in actual use in the United States.

IN a series of papers in the *Proceedings of the Royal Society of Victoria* (n.s., vol. xviii., part i., August) Messrs. Thiele, Chapman and Hall add to the knowledge of the Palæozoic rocks and fossils of Gippsland. A series of graptolites, including both some new forms and several

well known British species, mark the Ordovician age of certain black slates; a new species of Receptaculites comes from Silurian rocks, while some Devonian fossils are re-described.

THE frequent association of the acid igneous rock granophyre with the basic gabbro has attracted the attention of many geologists, and two explanations have been offered—(1) that the two rocks have been differentiated, during slow consolidation, out of a uniform magma of intermediate composition; and (2) that one of them represents the unaltered original magma, while the other has been formed by part of it absorbing and assimilating foreign material. Mr. R. A. Daly, of the International Boundary Commission, describes (*Amer. Journ. Sci.*, 4th ser., vol. xx., No. 117, September) cases he has observed in British Columbia and elsewhere which appear to him to prove conclusively the second theory to be correct. Gabbro-sills, intrusive in a quartzite, have been converted into an acid rock along the upper contact by absorption of silica from the quartzite, the other rock constituents retaining very nearly their original proportions.

WE have received the report on rainfall registration in Mysore for 1904 prepared by Mr. J. Cook, director of meteorology in that province; it contains valuable statistics relating to the seasonal and geographical distribution over that extensive area. The number of Government stations is now 201; but with regard to a few of the stations the director has to lament culpable inattention on the part of the officials concerned, who have allowed the gauges to lie for months without being suitably fixed. Among the heavy falls in twenty-four hours may be specially mentioned 20·67 inches in June, in the Shimoga district, and 13·70 inches in July, in the Kadur district. The geographical distribution is plainly exhibited by two maps, one for the year 1904, and another showing the average for thirty-five years, 1870–1904; the abnormality of the distribution owing to the failure of the north-east monsoon rains is strikingly represented. The thirty-five years' average for the whole province is 37·12 inches; the average for the Kadur district is 74·26 inches, and for the Chitaldrug district 21·46 inches.

PROF. STOUT's paper on "Things and Sensations," read to the British Academy in May, has been published by Mr. Henry Frowde. Prof. Stout maintains that the problem for philosophy is not, Is there an external world? but *What* is the external world, and how do we know it? He points out that in one aspect the thing and its sensible appearance are regarded as entirely one, and in another aspect as separate and independent. He rejects the solution that the sensible appearance is merely the thing itself appearing, examines hastily but suggestively the views of Locke and Kant, and comes to the conclusion that there is an actual existence other than sensation. This he calls the independent not-self, and he describes it as not unknowable and as not matter, but only one constituent of the complex unity which we call matter. In the concluding section of his admirable essay he argues that we must apprehend this independent not-self as another self, or as a partial aspect of another self more or less like our own.

THE fifth volume of the new series of the *Proceedings of the Aristotelian Society* has been published by Messrs. Williams and Norgate at 10*s.* 6*d.* net. The volume includes the papers read before the society during the session 1904–5, an abstract of minutes of the proceedings, and the report of the executive committee.

THE first two parts of a "Three Years' Course of Practical Chemistry," by Messrs. George H. Martin and Ellis Jones, science masters of the Bradford Grammar School, have been published by Messrs. Rivingtons at 1*s.* 6*d.* each. The second part, dealing with the work of the second year of the course, was originally published privately, and was reviewed in our issue for December 1, 1904 (vol. lxxi. p. 100). An introduction to each volume has been provided by Prof. J. B. Cohen.

AMONG the articles in the current number of the *Quarterly Review* is one dealing with the aborigines of Australia, written by Mr. Andrew Lang. This article reviews the work of the chief observers of the primitive peoples of Australia, examining exhaustively the researches of Mr. A. W. Howitt, Mr. F. J. Gillen, and Prof. Baldwin Spencer. Mr. Lang differs from all these on some points of theory, though he is profuse in his admiration of the matter and manner of their work, except as regards linguistic and philological research. The hypothesis put forward by Mr. Lang is the converse of that apparently entertained by Messrs. Spencer and Gillen. To quote the concluding paragraph of the article:—"they probably regard the Arunta lack of religion as primitive, just as they think the totemism of the Arunta most archaic. They do not indulge in the comparative method in either case; and it is the comparative method that leads us to our conclusions." The same number of the review contains an article on food supply in time of war.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

Nov. 3. 13h. 35m. to 14h. 56m. Transit of Jupiter's Sat. III. (Ganymede).
,, 5. 10h. 59m. to 12h. 4m. Moon occults σ Aquarii (mag. 4·8).
,, 9. 15h. 52m. to 16h. 51m. Moon occults ν Piscium (mag. 4·7).
,, 13. 6h. 35m to 7h. 16m. Moon occults α Tauri (mag. 1·1).
,, 13. 9h. 7m. Minimum of Algol (β Persei).
,, 14–16. Epoch of Leonid shooting stars (Radiant $151° + 23°$).
,, 15. Venus. Illuminated portion of disc $= 0·930$. Of Mars $= 0·879$
,, 16. 5h. 56m. Minimum of Algol (β Persei).
,, 17–21. Epoch of Andromedid shooting stars, with probable maximum November 18 (Radiant $25° + 43°$)
,, 20. Saturn. Major axis of ring $= 39''·62$, Minor axis $= 7''·88$.
,, 23. 21h. Jupiter in opposition to the Sun.
,, 24. 18h. Venus in conjunction with the Moon. Venus 3° 42′ S.
,, 26. 17h. Mercury at greatest elongation, 21° 41′ E.
,, 27. 18h. Mercury in conjunction with the Moon. Mercury 6° 33′ S.

WAVE-LENGTHS OF SILICIUM LINES.—Because of their especial utility in radial-velocity determinations, Prof. Frost and Mr. J. A. Brown have re-measured the wave-lengths of the silicium lines at $\lambda\lambda$ 4553, 4568, and 4575, which were simultaneously identified by Sir Norman Lockyer and Mr. Lunt, and designated "group iii." by the former observer.

The three spectra measured in this new determination were obtained by passing a strong spark between poles containing metallic silicium and titanium, the sharp titanium lines providing useful standards of wave-length in the subsequent calculation. As a titanium line occurs near enough to the silicium line at λ 4553 to interfere with the measures of the latter, only those photographs were used on which the faintness of the other titanium lines showed that this possible source of error might be neglected.

As a result of this research the following values were obtained for the wave-lengths sought:—λ 4552·64,

λ 4567·90, and λ 4574·70. The values obtained by previous observers are given below for comparison:—

	λ	λ	λ
Gill (from stars)	4552·79	4567·90	4574·68
McClean (from stars)	4552·6	4567·5	4574·5
Lockyer (spark)	4552·8	4568·0	4574·9
Exner and Haschek (spark)..	4552·75	4567·95	4574·9

The importance of having the exact wave-lengths of these lines in stellar radial-velocity determinations is shown by the differences which would be introduced into Prof. Frost's recent work on the *Orion* stars by the change from Exner and Haschek's values, as given above and previously used by Prof. Frost, to the new wave-length values. They are as follow:—

λ	Correction (Frost and Brown—Exner and Haschek) In λ	In kilometres
4553	−0·114 tenth-metres	= −7·51
4568	−0·053 ,,	= −3·48
4575	−0·109 ,,	= −7·14

REPORT OF THE YERKES OBSERVATORY.—Prof. Hale's report of the work performed at the Yerkes Observatory during the year ended June 30, 1904, has just been received, and shows that, during that period, neither the results obtained nor the private pecuniary support accorded to the institution fell below the average of previous years.

The Carnegie Institution of Washington has renewed the grant of 4000 dollars made to the observatory for the previous year, and the money is to be employed in furthering the investigations of stellar parallaxes, the observations of variable stars, and the reduction of the solar photographs obtained with the spectroheliograph of the Kenwood Observatory during the years 1892–5.

The Snow telescope, which was destroyed by fire in December, 1902, has been rebuilt from a gift of 10,000 dollars made by Miss Snow, and has since been erected at the Mount Wilson Solar Observatory.

A gift of a further 10,000 dollars from the Carnegie Institution provided for an expedition, for solar research, to Mount Wilson, where an independent observatory has since been erected under the direction of Prof. Hale, who thus severs his more immediate connection with the Yerkes Observatory.

The Bruce telescope having an aperture of 10 inches and a focal length of 50 inches has now been completed, and, under the direction of Prof. Barnard, is yielding splendid results. This telescope gives sharp definition over a field about 9° in diameter.

The 40-inch refractor is used for the Rumford spectroheliograph, the Bruce spectrograph, and several other attached instruments, and continues to give increased satisfaction.

After describing the above, Prof. Hale gives a somewhat detailed account of the excellent work performed in each department, and thereby shows what an important place in the astronomical world is filled by the Williams Bay observers and observatory.

OBSERVATIONS OF JUPITER'S SIXTH SATELLITE.—The results of a series of photographic observations of Jupiter's sixth satellite, made at Greenwich with the 30-inch reflector of the Thompson equatorial during August, September, and October, are published in No. 4051 of the *Astronomische Nachrichten*. Thirteen photographs were obtained on eight nights, and the time and length of each exposure, and the position angle and distance determined therefrom, are given in the table published. So far as possible, the two latter quantities have been compared with those given by Dr. Ross's ephemeris which appeared in No. 4042 of the *Astronomische Nachrichten*, and the differences are appended.

In order to facilitate the measuring process, the over-exposed image of Jupiter, on each plate, was reduced with ferricyanide of potassium, leaving an easily measurable reversed image, but the present results are to be considered as only provisional.

THE SPECTRUM OF NOVA PERSEI NO. 2.—No. 3, vol. lvi., of the Harvard College Observatory Annals contains a detailed *résumé* of the spectroscopic results obtained at the observatory in connection with Nova Persei No. 2.

Particulars of the photographs obtained are first given, and then each plate is discussed in order, and a description of the spectral changes and of the principal lines in the spectrum given. Special remarks are made in reference to any peculiar appearance or changes in the spectrum, such as took place when the star was rising to its maximum brightness and subsequently when its magnitude was oscillating. In this connection an interesting comparison is drawn between the changes which take place in the spectrum of Mira Ceti during the light-variations of that star and those which were observed in the Nova spectrum. From this comparison it is deduced that both in the case of Novæ and variable stars of long period the hydrogen lines do not become bright until the star has attained a large portion of its light.

REDUCTION TABLES FOR EQUATORIAL OBSERVATIONS.—Appendix No. 3 to vol. iv. of the Publications of the U.S. Naval Observatory contains a series of tables for the reduction of equatorial observations.

These tables have been compiled by Mr. C. W. Frederick, who, in the introduction to them, develops the formulæ for the construction of the tables of differential refraction for micrometer observations made with an equatorial, describes a method of determining the instrumental constants, and explains the use of the six tables included in the work.

The first three tables show the corrections for differential refraction, for the latitude of the Washington Observatory, to be applied separately according to the method of observation pursued.

Tables iv., v., and vi. give the instrumental constants of the 26-inch equatorial, of the Naval Observatory, for use under analogous conditions.

PHOTOGRAPHIC STAR CATALOGUE.—From a communication made by M. Lœwy to the Paris Academy of Sciences, we learn that the first volume of the "Catalogue photographique du Ciel" has been published by the Bordeaux Observatory, relating to the region dec. +16° to +18°, which they undertook to observe. This volume contains the rectilinear coordinates of 49,772 stars, and completes the set of four similar publications undertaken by the French observatories (Algiers, Paris, Toulouse, and Bordeaux) as part of the international cooperative scheme (*Comptes rendus*, October 9).

GEOGRAPHY AT THE BRITISH ASSOCIATION.

IN arranging the programme of work for the South African meeting, the organising committee of Section E tried to secure papers summarising the geographical conditions of the "subcontinent," as it is locally called, or those dealing with general geographical problems. The number of papers by South Africans was smaller than might have been expected, the local committee discovering that geography was the subject for which it was most difficult to secure papers. South Africa is in the position of having many specialists interested in geographical aspects of their specialisms, but has as yet no geographers giving all their time and energy to the subject.

In spite of this, the programme of the section was a full one, and it would have been difficult to dispose of more business than was accomplished.

It will be most convenient to consider first those papers which deal with Africa.

Mr. H. C. Schunke Hollway, vice-president of the section, communicated a paper on the outlines of the physical geography of the Cape Colony. This was illustrated by a new orographical map specially prepared by the Surveyor-general, Mr. Cornish-Bowden, showing contour lines at 1500, 3000, 4000, 6000, and 8000 feet. Unfortunately, sufficient data for plotting the 500-feet contour line—one of the most interesting of all—do not exist; and even the lines shown on this map are only approximations. Here, at the outset, the lack of a good topographical map was bewailed, and throughout the wanderings of the members in South Africa this deficiency was felt at every

turn. Mr. Schunke Hollway traced the first efforts to obtain levels, and showed how the railway surveys had been the chief means of securing the knowledge we possess of relief. He then discussed the natural divisions of the Cape Colony, distinguishing (1) the coast, and (2) the Orange River basin. The coast, varying from 80 miles to 170 miles wide, he divided into (*a*) the eastern region, a narrow tract of land which rose in terraces from the sea, east of the south-east sweep of the Sneeuwbergen, Tandjesbergen, and Bankberg ranges, to where it dipped into the Fish River, and along that river to the sea; (*b*) the south-western region, which nearly coincided with the folded mountain belt, and stretched as a narrow zone of mountains not more than 85 miles wide from the Olifants River in the west to the Fish River in the east; (*c*) the lower Karroo region, a comparatively narrow strip of land between the southern mountain belt and the watershed, which extended from Uitenhage and Somerset East to the north end of the Bokkeveld Karroo, south of Calvinia; (*d*) the north-west coast region, which lay between the Olifants and the Orange rivers. The Orange River region consisted broadly of a hollow plain which sloped gently from east to west, with but few isolated ridges and hills scattered over its surface. It was 1000 miles long, rose to more than 3000 feet within 80 miles of the coast, and remained above this height for 250 miles in width. Seen from the tableland, the Roggeveld and other bordering mountains seemed insignificant, but seen from the Karroo the escarpment presented the appearance of a magnificent mountain range. This rose to the Drakensbergen or Kahlamba mountains in the east, 180 miles of which lay within the colony, with an average ridge level of 8000 feet. In the west, valleys containing settlements at more than 6000 feet were to be found. After a detailed examination of each region, its economic conditions were briefly discussed, and their relationship to rainfall pointed out.

The physical geography of the region further north was discussed in Mr. Tudor Trevor's paper on the physical features of the Transvaal. He divided the country into:—(1) the plateau country or High Veld; (2) the slopes of the plateau locally called Banken; and (3) the basement country locally called Low or Bush Veld. These were subdivided as follows:—

		Square miles	Per cent
High Veld	True High Veld	14,900	12·7
	Middle Veld	18,800	16·0
	Outliers (Zoutpansberg and Waterberg)	4,400	3·7
	Total	38,100	32·4
Slope Country	Main Slope	19,700	16·7
	Outliers (Zoutpansberg and Waterberg)	7,400	6·3
	Total	27,100	23·0
Low Veld		52,000	44·6
	Total	117,200	

He described the water systems and pointed out the absence of alluvial deposits, and directed attention to the steady diminution of the water in springs in recent historic times.

Mr. F. S. Watermeyer dealt with a wider area in his geographical notes on Africa south of the Limpopo. He gave a brief historical sketch of the cartography of South Africa, a summary of the history of its population, and an account of the physical features and climatic conditions, especially with regard to the influences on the development of pastoral and agricultural pursuits.

Mr. C. Stewart, Government meteorologist, communicated at Cape Town a paper on the climate of South Africa. The uniformity of mean annual temperature was pointed out—the Royal Observatory, Cradock, Bloemfontein, and Johannesburg being all about 62° F.—the higher altitude neutralising the lower latitude. The mean temperature curve was at a maximum in February; it fell rapidly until June, slightly to July, and rose with a peculiar flattening in September to the maximum. The minimum of the year occurred in a cold spell in July. The flattening in September was associated with an increase in the cloud curve coincident with the change in the prevailing winds from north-west in August to south in September. As to rainfall, there were three regions:—(1) the south-west winter rain region; (2) the small area in the south of constant rains; and (3) the east, with summer rains. Rain came with north-westerly winds in the west, with south-westerly winds in the south and east, and sometimes with north-easterly winds in the east.

Remarkable winds, locally called "Berg winds," blew from the plateau at right angles to the coast and raised the temperature. At Port Nolloth they blew when depressions were commonest in South Africa—from autumn through winter to spring—and made it warmer in winter. The storms of South Africa were associated with Λ depressions, and so were similar to those of southern Australia.

Mr. Hutchings read a paper on the indigenous forests of South Africa. He divided them into:—(1) the dense evergreen indigenous forests of which yellow-wood was the chief species, commonly called the yellow-wood forest; (2) the open timber forest, which generally occupied drier country than the yellow-wood forest, and was of inferior type, though it might contain trees of first importance, such as the cedar forest of Clanwilliam and the Rhodesian teak (*Afzelia cunanzensis*) forest of Wankie; (3) the scrub forests of the dry, hot coastlands and portions of the interior, where the rainfall was scanty and uncertain. There was no timber of large size in the scrub forests, and not much in the open timber forests. The yellow-wood forests were found in the rainy regions of the south coast, where they appeared as dense evergreen woods disposed in two storeys. The lower storey was formed by stinkwood, assegai, hard pear, ironwood, &c., and the upper storey by the large yellow-wood trees, which attained the stature and dimensions of the largest oak trees in Europe. For 1200 miles from Cape Town to the north-east Transvaal the species remained much the same, but in the Rhodesian forests most of the trees were deciduous and of different species to those of the yellow-wood forest.

Major Stevenson Hamilton, warden of the game preserves, gave an interesting account of the past and present distribution of game in the Transvaal, and of the attempts which were being made, with gratifying success, to prevent its extermination.

Two papers dealt with Africa as a whole. Mr. J. Bolton discussed the boundaries and areas more particularly of British colonies and protectorates. The boundary treaties and agreements which have resulted in boundary surveys were specially treated, as these surveys are almost the only pieces of scientific map-making in the continent.

Messrs. Herbertson and Waite showed a new map of the annual rainfall of Africa, based on all available data.

Two papers were communicated on surveying and mapping. The triangulation of the gold fields was described by Mr. van der Steer, who had helped Mr. Melville, vice-president of the section, to carry out the triangulation of the central and most important section. This paper will be published in full in the *Journal of the Institute of Land Surveyors of the Transvaal*.

Colonel Johnston, late director-general of the Ordnance Survey, gave a very clear account of the history and work of the survey, and described the various maps which it issues, illustrating his remarks by specimens and by lantern slides. He pointed out the various advantages to be derived from a topographical survey of South Africa, and showed that it need not be so expensive an operation as was commonly supposed.

There were very few papers dealing with geographical exploration. At Cape Town Mr. L. Bernacchi lectured on the results of the National Antarctic Expedition with the *Discovery*, in which he paid special attention to the magnetic and meteorological results. Mr. Ferrar, another member of the expedition, gave an evening lecture at Pietermaritzburg on the same subject. A paper on the volcanic Gough Island, by Mr. Rudmose Brown, of the

Scottish Antarctic Expedition, was read at Cape Town. Two new buntings, a rich marine fauna, and three new species of plants were obtained. The desirability of further exploration from South Africa was pointed out. In the course of the discussion it was suggested that a meteorological station on Gough Island might be of use to South African weather services. Mr. Yule Oldham gave a summary of the history of the discovery of the coasts of Africa, illustrated by an admirable selection of lantern slides of contemporary maps, showing the various stages in the progress of discovery. The proceedings at Johannesburg were opened by Mr. Douglas W. Freshfield, who described the Sikhim Himalayas, and the route followed by our troops towards Lhasa; this was the only other record of travel. Mr. Freshfield delivered one of the evening lectures at Durban, choosing for his subject "Mountains."

Some interesting discussions took place on questions of physical geography at a joint meeting with the geological section, an account of which will shortly be published. At Johannesburg, Prof. Davis, of Harvard, communicated a paper on the geographical cycle in arid areas—a deductive essay based on observed facts. Starting from suggestions in Prof. Passarge's great work on the Kalahari Desert, he traced the probable sequence of land forms in an elevated and arid region rarely subjected to water erosion, illustrating his remarks by admirable blackboard sketches. He pointed out that, starting with a rough, uneven land, the occasional water erosion would not be related to sea-level, and at an early stage the depressed areas would be slowly filled up, forming lakes of rock waste. In course of time, the slopes would be so worn down and adjacent basins so filled that one communicated with its neighbour. Ultimately a large "integrated" basin would be formed; wind action would increase with smoothness, and might even transport waste outside arid area. This would waste the whole surface and reduce it to a common level, and wearing away by wind might even lower the surface below sea-level. It was suggested that wind erosion might explain the pans of the Transvaal, the origin of which had occasioned considerable speculation.

Two papers were of special interest to teachers of geography. Captain Ettrick W. Creak, F.R.S., vice-president of the section, maintained that the use of globes was essential in teaching geography, and that systematic lessons should be given with globes.

Mr. J. Lomas showed how excursions could be used in teaching geography, and illustrated his points by views taken on some excursions which he had conducted.

The committee of the section asked for the re-appointment of the committees on researches in the Indian Ocean, and on the local names given to geological and topographical features in different parts of the British Isles. They, along with sections B, C, and E, asked for the appointment of a committee to report on the quantity and composition of rainfall and the discharge of lakes and rivers in different parts of the globe.

The whole journey from England to the Victoria Falls and back may be regarded as the longest, most interesting, and most profitable geographical excursion ever made by the section. This has been described in NATURE by another pen, and so need not be recapitulated here. In South Africa the most elaborate special excursions were those arranged by the geologists, and the long trek from Pretoria to Mafeking. These permitted members to see the country more intimately than was possible from the train. The thanks of those geographers who were allowed to take part in these must be recorded.

Since the above was written, the sad news has come that the president of the section, Admiral Sir William Wharton, died at Cape Town on Thursday, September 28, after a short illness. The value of the proceedings in this section was greatly increased by his intimate knowledge of many parts of the world, by his keen interest in all geographical problems, and by the genial way in which he induced those present to take part in the discussions. An account of his career was given in NATURE of October 12 (p. 586), but the writer may be permitted to say how very much the success of the meetings of the geographical section was due to the president, whose loss will be deeply deplored by all who were privileged to come in contact with him.

THE CHELSEA POWER STATION.[1]

THE development of electric traction as applied to railways in Great Britain is about to make one more step forward with the electrification of the underground railways in London, and as this scheme is almost complete, a short description of the power scheme may be of interest.

In most large power schemes that have been completed during the last few years, it has not always been convenient to place the main power station near the centre of the system of power distribution, owing to cost of ground, &c., but this difficulty is got over by employing a number of small distributing stations which are conveniently situated in the area of supply, and are supplied with power from a large main generating station.

The main generating station of the underground electric railway will supply the entire power necessary for the working of the Inner Circle, which it is working in conjunction with the Metropolitan Railway Company's station at Neasden, and for the whole of the District Railway. It will also furnish power to the Baker Street and Waterloo, and the Great Northern, Piccadilly, and Brompton tube railways on their completion.

Coal for the boilers' furnaces is lifted out of barges by two large cranes, each working a 27-cwt. grab bucket, which deposits it in a holder where it is automatically weighed. From the holders the coal is carried by means of automatic conveyors to the coal bunkers, which are situated in the top of the boiler house immediately over the boilers. The coal falls from these through chutes to automatic stokers as required, and as the ash accumulates beneath the boiler furnaces it is removed by means of an ash railway. Thus the handling of the coal is almost wholly automatic from the moment the coal leaves the barges until it is returned to the barges as ash.

The boiler house consists of a basement and two floors, and is 450 feet long by 100 feet wide. In the basement there are eight pumps for pumping the water into the boilers. The boilers are on two floors, each containing thirty-two boilers, with floor space available for eight more boilers on each floor should they be required. They are divided into groups of eight, and each group supplies steam direct to the steam turbine engine to which it is permanently connected. Each group is fitted with economisers for heating the water before it is pumped into the boilers.

The main engine-room is 75 feet wide by 450 feet long, and consists of a basement and one floor.

The eight horizontal steam turbine engines are each coupled direct to a three-phase alternating current generator, and it seems hardly conceivable that each one of these sets is capable of transforming the heat energy of the coal into electrical energy equivalent to 7500 horse-power, while the total output of the station is 76,000 horse-power. The electrical generators are of the fixed armature type, having a four-pole revolving field, and generate at a pressure of 11,000 volts. A system of forced lubrication is employed on the turbines, thus ensuring efficient lubrication.

In addition to the above, there are four high-speed engines of 175 horse-power connected to generators which supply the magnetising current for the revolving fields. The condensing system for condensing the steam after it has performed its useful functions in the engines is very ingenious, and is so arranged that the pumps for pumping the cooling water through the condensers have merely to overcome the friction of the pipes.

One of the most interesting features of the whole system is the switch-board and control system. The system employed aims at having the entire control of the generating in a small space, and at the same time having no dangerous voltages on any part of the control board.

The system is almost analogous to the nervous system of the human body, having the control board as the brain, which it virtually is. All the big high-voltage switches are operated by small electric motors, and it is these motors which are operated from the control board, and as a low-voltage current is used for this purpose

[1] Abstract of a paper read before the students' section of the Institutio of Electrical Engineers by Richard F. Chaffer.

there is little or no danger to the operator through faulty switch-gear.

The switch-board proper is carried by three galleries extending the whole length of the north side of the engine-room and continued along the east end. The control board is on the middle gallery and projects slightly, so that the operator has a clear view up and down the engine-room. From the switch-board the energy is distributed to the various substations situated at various points along the system, and it is there converted to low-voltage direct current at 550 volts, and thence distributed to the live rail. Throughout the whole station it is remarkable to find the extent to which labour-saving devices are employed.

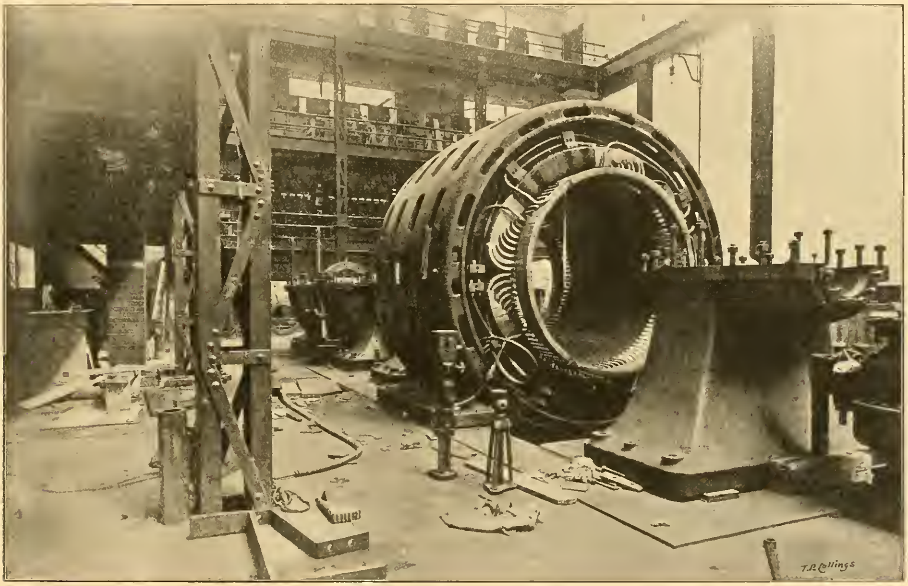


FIG. 1.—Armature of 5500 K.W. Generator.

Thanks are due to Mr. Chapman, general manager and chief engineer, for permission to view the station, and to the Institution of Electrical Engineers for the accompanying illustration of the armature of one of the generators.

REPLICAS OF DIFFRACTION GRATINGS.

FROM an article in No. 2, vol. xxii., of the *Astrophysical Journal*, we learn that Mr. R. J. Wallace, of the Yerkes Observatory, has attained great perfection in the production of replicas from plane diffraction gratings. After some amount of previous research, he decided on following Thorp's method in its essentials with several modifications which his experience suggested. Mr. Thorp first flooded his original grating with high-grade oil before pouring on the celluloid solution on which the replica was made. Mr. Wallace found it better to omit the oil. In the original method a solution of gun-cotton in amyl acetate with camphor added was employed as the material for the replica, but Mr. Wallace found that he could obtain much clearer and brighter copies by not adding the camphor. His successful solution is made by dissolving 38 grains of Anthony's pure snowy cotton in $2\frac{1}{4}$ ounces of pure amyl acetate, precipitating the resultant collodion in a large tray of pure water—constantly agitating the mixture—thoroughly drying the precipitate, and then re-dissolving it in the same quantity of pure amyl acetate. The collodion thus obtained is carefully filtered, and is then ready for use.

The grating to be copied is levelled in a roomy drying cabinet, which, in order to preclude dust particles, should be as free from draughts as possible, the surface dusted with a soft camel-hair brush, and the collodion flowed over it evenly. The author uses about twenty-five drops of the solution in copying a 2-inch grating. The grating is then replaced on the levelled support and left to dry for about eight to twelve hours; the longer the drying period the better is the resulting copy. After being thoroughly dried the grating is placed in pure distilled water at normal temperature together with the glass ("white optical crown") support, which has previously been evenly coated with the adhesive medium, plain hard gelatin. After a few minutes' soaking the edge of the film may be sprung from the grating, and the whole of it is then detached and *immediately* placed on the previously prepared gelatin surface and clamped there. Perfect contact is obtained by drawing a piece of the softest velvet rubber *very lightly* over the surface in the direction of the length of the lines.

The contraction suffered by the replica during the twenty-four hours' drying period slightly alters the number of lines per inch, but the effect is very small. In some of Mr. Wallace's copies this alteration produced 572 lines per mm. instead of the 568 lines that occupied the same space on the original. Two reproductions of the solar spectrum, one taken with the original grating, the other with the copy, show the resulting increase of dispersion caused by the contraction, and also show that everything which is resolved by the original grating is also resolved equally well under the same conditions by the copy.

The grating replicas, unmounted, transmit the more refrangible radiations up to λ 2013, practically without absorption, but the glass used as supports for the copies is opaque beyond λ 3400, therefore Prof. Wood has proposed that mica should be employed for the supports where "ultra-violet" work is to be prosecuted. Reproductions of some spectrograms obtained with and without the mica screens show the value of Prof. Wood's suggestion.

Mr. Wallace recommends the "copying" process as the most efficient method of cleaning a dirty grating, and he has also tried it for the production of replicas of concave gratings, but as yet without any notable success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. T. S. Moore has been elected to a fellowship at Magdalen College after an examination in chemistry. Mr. Moore was educated at the East London Technical College; he gained a postmastership in natural science at Merton in 1898, was placed in the first class in mathematical moderations in 1900, and in the natural science school in 1902. He was lately appointed lecturer in chemistry in the University of Birmingham.

St. John's College recently procured an important change in its statutes which will be of great assistance in the new forestry scheme. The college was bound by the statutes of 1877 to endow a chair of mechanics and civil engineering so soon as its revenue permitted; by the new statute this obligation is removed, and instead St. John's is to contribute in and after 1908 600*l.* a year to the Sibthorpian professorship of rural economy. It is understood that the main subject to be entrusted to the future professor is pathological botany, so that he will have an important share in the instruction of the forestry students. St. John's has also placed a considerable plot of land near Bagley Wood at the disposal of Prof. Schlich for the purpose of starting a "forest garden."

At the first meeting of the delegacy which is to superintend the instruction of the Indian forestry students Prof. Schlich was appointed secretary, and Mr. D. H. Nagel (Trinity College) assistant secretary.

Prof. Osler and Prof. Miers were among the new members of the hebdomadal council who were elected on October 26.

The examinations for natural science scholarships this term will take place at the following dates: December 5, Balliol, Christ Church, and Trinity; December 12, University, Lincoln, and Magdalen; December 19, Jesus College.

CAMBRIDGE.—A memorial has been presented to the council of the senate requesting the council to take steps by the nomination of a special syndicate or otherwise to ensure the consideration of the following questions:—(1) the advisability of imposing on all such candidates, as may not otherwise be qualified for exemption, the passing of the previous examination or of another examination, in lieu of the previous examination, as a condition precedent to matriculation in the university; (2) the possibility of obtaining the cooperation of the University of Oxford with the University of Cambridge in establishing a joint examination which should qualify for matriculation in either university. This memorial has been signed by some seventy influential members of the university. It has been referred by the council of the senate to the studies and examinations syndicate.

The electors to the Allen scholarship give notice that they are prepared to receive applications from candidates. Any graduate of the university is eligible for the scholarship provided that his age on the first day of the Lent Term 1906 does not exceed twenty-eight years. Next year the scholarship is open to candidates who propose to undertake research in medicine, mathematics, physics and chemistry, biology and geology, moral science. The scholarship is tenable for one year, during which period it will be the duty of the student to devote himself to research in Cambridge or elsewhere. The emolument of the student is 250*l.*, or such smaller sum as the fund, after payment of all expenses, shall be capable of providing. Every candidate must send to the Vice-Chancellor, Trinity Hall Lodge, on or before February 1, 1906, his name and a definite statement of the course of research which he proposes to undertake, together with such evidence of his qualifications as he thinks proper, and with the names of not more than three referees to whom the electors may apply for information. The election will be made towards the end of the Lent term, 1906.

In its report upon its reserve fund, the museums and lecture rooms syndicate enumerate a number of varying sums spent upon the museums. It has granted 100*l.* toward the expenses of housing Prof. Bonney's collections in the Sedgwick Museum, and has also allotted some smaller sums to the furnishing of the rooms in the new medical schools. It is a pity there are not sufficient funds at the disposal of the syndicate to fit up the Humphry Memorial Museum, the bare walls of which cry for shelves and showcases.

THE annual general meeting of the Association of Teachers in Technical Institutes will be held at the Birkbeck College on Saturday, November 4, at 3 p.m., with Mr. W. J. Lineham, chairman of the association, in the chair.

A COURSE of eight lectures on fields of force will be given in Columbia University, New York City, by Prof. V. F. K. Bjerknes, professor of mechanics and mathematical physics in the University of Stockholm, on Fridays and Saturdays in December. The lectures will be open, without charge, to teachers and advanced students in physics. During March and April, 1906, a course of lectures will be given by Prof. H. A. Lorentz, professor of physics in the University of Leyden.

THE Berlin correspondent of the *Times* states that in the presence of the German Emperor, the American Ambassador, the German Foreign Secretary, the Prussian Minister of Education, and other men of distinguished eminence, an inaugural lecture was delivered in English by Prof. Peabody, of Harvard University, in the central hall of Berlin University on Monday, October 30. Prof. Peabody discussed the advantages of the scheme put forward by the German Emperor for the exchange of lecturers between German and American universities, and read a letter which he had received from President Roosevelt approving of the scheme.

WE have received an advance copy of the report of the work of the department of technology of the City and Guilds of London Institute for the session 1904–5. The report refers to some of the ways by which the institute is able to cooperate with the central educational authorities for Great Britain and Ireland, in assisting and guiding schools in their arrangements for the provision of technological instruction, and in effecting a proper coordination between workshop and class teaching. The department of technology suggests schemes for complete courses of evening instruction for artisans and others engaged in different industries, and prepares detailed syllabuses in the technology of each trade subject. The institute registers classes in any of the subjects contained in its programme, provided the conditions preliminary to registration are fulfilled. During the past session 2601 classes were registered in 364 towns. These were attended by 41,618 students, being 671 more than in the previous session. Before registering a class, the institute requires that the qualifications of the teacher shall be submitted to, and approved by, the department of technology. During the session under review, 195 new names have been added to the institute's register of teachers in technology, and 149 have been provisionally approved. The institute has inaugurated a system of inspection of trade classes by professional experts. During the past session 149 classes were inspected by members of the institute's staff. The report also contains full statistics relating to affiliated technological classes, and instructive extracts from some of the examiners' reports on the results of the examinations, 1905.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 18.—Dr. T. A. Chapman, vice-president, in the chair.—Mr. H. **Rowland-Brown** exhibited series of Erebias taken this year in the Pyrenees, including *Erebia lefebvrei*, with the varieties *pyrenaea*, Obth., from Mt. Canigou, E. Pyrenees, and var. *intermedia*, Obth., from Gavarnie. He also showed for comparison *E. glacialis* var. *nicholli*, from Campiglio, which at one time was supposed to be identical with *lefebvrei*, then considered to be the Pyrenean form of *E. melas*; specimens of *E. gorgone* and *E. gorge* from the Lac de Gaube, Cauterets, and from Gavarnie; and a short series of *Lycaena orbitulus* from the Central Alps, *L. orbitulus* var. *oberthuri*, Stgr., *L. pyrenaica*, and *L. pheretes* from the Brenner and Cortina districts. It was remarked that there seemed to be a greater superficial affinity between *pyrenaica* and *pheretes* (not reported from the Pyrenees) than between *pyrenaica* and *orbitulus*.—Mr. E. C. **Bedwell** exhibited eight specimens of *Apion laevigatum*, Kirby, one of the rarest indigenous Apions, found on August 31, sheltering under plants of *Echium vulgare* in the Lowestoft district.—Mr. R. **Shelford** showed a Ligæid bug, the fore-limbs of which were remarkably well adapted to fossorial habits and comparable with those of the mole cricket; a Brenthid beetle with a deep channel running along the dorsal part of the prothorax and occupied by achari; and an Anthribid beetle with a crescentic sulcus on the prothorax. All the specimens were from British North Borneo.—Mr. C. J. **Gahan**, on behalf of Mr. C. O. Waterhouse, exhibited a living example of *Phaneroptera quadripunctata*, which species had been found in some numbers in a vinery near Chester.—Mr. W. J. **Kaye** brought for exhibition a long variable series of *Heliconius numata* from the Potaro River, British Guiana, clearly proving that these very variable forms were only aberrations, and not a subspecies, at least in this locality.—Mr. A. H. **Jones** exhibited a collection of Lepidoptera made by him in Majorca during the first half of last June, and remarked upon the great scarcity of lepidopterous life in the island. Only thirteen species of butterflies were observed, all of the commonest kinds and without any indication of variation, with about six species of moths (all occurring in Britain), including *Agrotis saucia*, *Acidalia ochrata*, and *A. degeneraria*, the latter, interesting in point of colour, being much redder. Mr. Jones also exhibited *Melanargia lachesis* var. *canigulensis* from Le Vernet, showing on the under side in the males a strong resemblance to *M. galathea*, and *Melitaea aurinia* var. *iberica*, Obth., from Montserrat, near Barcelona, and a melanic specimen of *Erebia stygne*, taken by Mr. R. S. Standen last June at St. Martin du Canigou, Le Vernet.—Mr. F. P. **Dodd** communicated a paper on a parasitic Lepidopteron from Queensland, Australia.—Commander J. J. Walker read a paper by Mr. E. G. R. **Meade-Waldo** on a collection of butterflies and moths made in Morocco, 1900–01–02. The species enumerated included a Cœnonympha and a Satyrus new to science. But for so luxuriant a country as that visited it was remarkable how few butterflies and moths were observed.

Royal Microscopical Society, October 18.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair. An old Wilson screw-barrel simple microscope, date about 1750, presented by Major Meade J. C. **Dennis**. The secretary traced the history of microscopes' focusing by means of a screw cut on the body-tube from Campani in 1686, Grindl in 1687, Bonanni in 1691, Hartsoeker in 1694, to Wilson in 1702, who was followed by Culpeper somewhere before 1738 and Adams in 1746.—A simple portable camera for use with the microscope: E. **Moffat**. The arrangement comprised a vertical telescopic standard, drawing out to 28 inches, having a clamp at the lower end for securing it to the edge of a table. At the upper end was fixed a mahogany board $\frac{3}{4}$ inch thick by 4 inches by 5 inches, hinged at the pillar so as to close up, and having a hole in the centre about 3 inches in diameter. There were two spring clips for securing the dry plate while making the exposure, and guides for keeping it in position horizontally. The back of the dry plate was covered by a piece of cardboard painted dead black, the spring clips referred to pressing upon this card. Depending from the board was a tapered bag of black Italian cloth about 17 inches in length, with a rubber ring at the lower end to secure the covering to the eye-piece of the microscope. The apparatus can be closed up into a space 5 inches by 9 inches by $1\frac{1}{2}$ inches, and will go into a large pocket or knapsack. The weight, if made of aluminium, should not exceed $1\frac{1}{2}$ lb. It will work well up to 700 diameters, and can be made in brass for 21*s*. Aluminium would cost more.—A form of hand microtome devised and used by Mr. **Flatters**. The microtome was made of brass, having the tube 3 inches deep and 1 inch diameter inside. The spindle had twenty-eight threads to the inch, and had a notched disc at the lower end, acted on by a spring stop the tension of which could be adjusted. Three discs were supplied, permitting sections being cut of 1/2000 to 1/1200 inch in thickness for each notch that the disc was turned. The knife-plate was made of *hardened* brass, the aperture on the under side being of the same diameter as the tube, but somewhat less on the upper side to prevent the specimen turning.—The Finlayson "comparascope": Messrs. R. and J. **Beck**. The president said they had the instrument before them some time ago in a less developed form; it seemed likely to be extremely useful to microscopists, as it could be applied to any microscope, and afforded a ready means of comparing objects directly under conditions which rendered it possible easily to detect slight differences.—Notes on aragotite, a rare Californian mineral: Prof. Henry G. **Hanks**. The mineral, which is a hydrocarbon, was first described by Mr. F. E. Durand in a paper read by him before the California Academy of Sciences on April 1, 1872. It was not until 1893 that Prof. Hanks obtained specimens of the mineral. These he subjected to various experiments, and disputes Mr. Durand's conclusion that it might be some modification of idrialite. He gives a table showing that in chemical composition, colour, streak, hardness, and specific gravity aragotite differs from idrialite.

PARIS.

Academy of Sciences, October 25.—M. Troost in the chair.—Some facts concerning the history of emulsin; the general existence of this ferment in the Orchidaceæ: L. **Guignard**. The examination of various parasitic plants showed the constant presence of emulsin; it would appear that there is a constant relation between the presence of this ferment and parasitism. On further work, however, this was not found to be the case, since a careful examination of *Orobanche Galii* and *O. Epithymum* gave no emulsin. Numerous plants of the Orchidaceæ, both indigenous and exotic, proved to have emulsin in their aërial and subterranean roots.—On the decapod Crustacea collected by the yacht *Princesse Alice* in the course of the voyage of 1905: E. L. **Bouvier**.—Report on a memoir of M. Bachelier on "continued probabilities": H. **Poincaré**.—Observation of the eclipse of the sun of August 30: F. **Jehl**. The observations were made at the Observatory of Aosta (Italy) under excellent atmospheric conditions, and included the times of contacts, visual observations of the spectrum, and temperature changes.—On discontinuous groups: Frédéric **Riesz**.—Researches on gravitation: V. **Crémieu**. The experiments described show the possibility of carrying out the Cavendish experiment in a liquid. Full details of the arrangement of the apparatus are given, but the publication of the results is reserved for a later paper.—On the specific inductive power of benzene and water: F. **Beaulard**. L. Grætz and L. Fomm have pointed out the existence of a phenomenon of polarisation which is in contradiction with the fundamental hypothesis of Poisson-Mossotti, and this relation has been utilised by the author as the basis of his method of measurement. The specific inductive powers thus found were 1·657 for benzene and 11·04 for water.—On the specific heat of solutions of copper sulphate: P. **Vaillant**. The solutions were heated by an incandescent lamp, the current and electromotive force being measured directly. If the specific heat of solution be regarded as the sum of that of the solid copper sulphate and water, negative values are obtained, but this is not the case if the substance in solution be regarded as $CuSO_4.5H_2O$. Even on this assumption constant values are not obtained for the specific heat, and several possible explanations are put forward.—

On the composition of the hydrochloroferric colloid as a function of the amount of HCl in the liquid: G. **Malfitano.**—On some aromatic ethylene oxides: MM. **Fourneau** and **Tiffeneau.** A study of the conditions under which the ethylene oxides tend to pass over into aldehydes.—New researches on the development of green plants: Jules **Lefèvre.** The author's experiments lead to the same conclusion as those of Moll and Cailletet, if carbonic acid is absorbed by the roots it is not utilised by the plant.—An analysis of some anthropometric measurements of men and women of the gipsies: Eugène **Pittard.**—Serotherapy in cases of bleeding: Émile **Weil.** In the cases known as "bleeders," in which a slight wound continues to bleed, it is shown that this effect is due to a property of the blood itself. This disease can be remedied by the injection of normal human or bovine serum. Details are given of the cure of one case, who, on the twenty-fifth day after the last injection, for the first time in his life, had a tooth removed with only the normal loss of blood.—The distribution of fine sediment on the bed of the ocean: J. **Thoulet.**

NEW SOUTH WALES.

Linnean Society, August 30.—Mr. T. Steel, president, in the chair.—Crustacea dredged off Port Jackson in deep water: F. E. **Grant.** Six species of Malacostraca were taken, of which four species, referable to the genera Hyastenus, Cymonomops, Latreillopsis, and Paguristes, are described as new. Of the remaining two species, *Ebalia tuberculosa* and *Ibacus alticrenatus,* only the former has previously been recorded as belonging to our fauna.—Notes on Prosobranchiata, No. 4, the ontogenetic stages represented by the gastropod protoconch: H. Leighton **Kesteven.** The present contribution is a continuation of the writer's attempts to unravel the puzzles presented by the gastropod protoconch. He finds that he is able to define four stages of growth represented, and supposes an "ideal" protoconch to be composed of (1) the "plug" of the primitive shell gland; (2) a portion formed by the veliger; (3) a portion formed during the nepionic stage; and finally (4) a portion formed during early neanic stages.—On a new species of Eucalyptus from northern New South Wales: J. H. **Maiden.** This is a large white gum, much resembling the blue gum (*E. saligna*) when growing, and the timber of which is specially esteemed. Its timber, however, as compared with that of *E. saligna,* is white from the sap to the heart. Its closest affinity appears to be with *E. Deanei,* Maiden.—A gelatin-hardening bacterium: R. Greig **Smith.** The bacterium was isolated from the tissues of *Schinus molle,* which was exuding a turquoise coloured gum-resin. When it was grown upon ordinary glucose gelatin, the medium became deep brown in colour, and was not liquefied when heated to the boiling point of water. Tannin, formaldehyde, or oxidising enzymes could not be detected.—On the supposed numerical preponderance of the males in Odonata: R. J. **Tillyard.** Reasons are given for concluding that the ratio of the numbers of the sexes in the dragon-flies or Odonata is a ratio of equality. The idea of the preponderance of the males, suggested largely by the examination of collections, and voiced from time to time by naturalists, has not been confirmed by experience in rearing a large number of nymphs of *Lestes leda.*

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 2.

CHEMICAL SOCIETY, at 8.30.—Solution and Pseudo-solution, part iv., Some of the Arsenious Properties of Arsenious Sulphide and Ferric Hydrate: E. Linder and H. Picton.—The Molecular Conductivity of Water: P. Blackman.—The Stereoisomerism of Substituted Ammonium Compounds: H. O. Jones.—The Influence of very Strong Electromagnetic Fields on the Spark Spectra of Ruthenium, Rhodium, and Palladium; J. E. Purvis.—Note on the Fluorides of Selenium and Tellurium: E. B. R. Prideaux.—The Constitution of Glutaconic Acid: J. F. Thorpe.—Some Alkyl Derivatives of Glutaconic Acid and of 2:6-Dioxypyridine: H. Baron and J. F. Thorpe.—Note on the Formation of β-Methylglutaconic Acid and of αβ-Dimethylglutaconic Acid: F. V. Darbishire and J. F. Thorpe.

LINNEAN SOCIETY, at 8.—Plant Ecology, interpreted by Direct Response to the Conditions of Life: Rev. G. Henslow.

RONTGEN SOCIETY, at 8.15.—The Ruhmkorff Coil: Prof. Wertheim-Salomonson.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Sea Defences: Baron H. T. H. Siccama.

FRIDAY, NOVEMBER 3.

GEOLOGISTS' ASSOCIATION, at 8.—Conversazione.

MONDAY, NOVEMBER 6.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Introductory Remarks: The President, Sir George D. T. Goldie, K.C.M.G., F.R.S.—Travels in the Mountains of Central Japan: Rev. Walter Weston.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Evaporation *in vacuo* of Solutions containing Solids: Dr. J. Lewkowitsch.

WEDNESDAY, NOVEMBER 8.

GEOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 9.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Continuum and the Second Number-class: G. H. Hardy.—On the Arithmetical Nature of the Coefficients in a Group of Linear Substitutions of Finite Order (second paper): Prof. W. Burnside.—On the Asymptotic Value of a Type of Finite Series: J. W. Nicholson.—On an Extension of Dirichlet's Integral: Prof. T. J. I'A. Bromwich.—(1) On Improper Multiple Integrals; (2) On the Arithmetic Continuum: Dr. E. W. Hobson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address: John Gavey, C.B.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—(1) Descriptions of New Species of Drymæus, Amphicyclotus, and Neocyclotus from Central and South America; (2) Description of a New Species of Achatina from Mashonaland: S. I. Da Costa.—On a Collection of Land and Freshwater Shells from Sumatra with Descriptions of New Species, part i.: Rev. R. Ashington Bullen. On a New Species of Oliva: F. G. Bridgman.—On the Anatomy of *Ensis macha* and *Solen fonesii* and *S. viridis*: H. H. Bloomer.

CONTENTS.

THURSDAY, NOVEMBER 9, 1905.

STRENGTH OF MATERIALS.

Mechanics of Materials. By Mansfield Merriman. Tenth edition, re-written and enlarged. Pp. xi + 507. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21s. net.

THE great development of engineering schools in the United States has led to the production of a considerable number of technical text-books primarily intended for students. It may at once be stated that, taken as a whole, these books are increasingly scholarly and sound; but they are largely compiled from similar European text-books, and often disclose a want of any serious independent investigation of the subject dealt with.

The present book is in some respects an excellent treatise, and as it has reached a tenth edition it must have been found useful. It deals with the elastic and, to a limited extent, with the plastic properties of materials of construction and the application of the laws of strength of materials to the simpler machine parts and structures. The treatment is essentially theoretical, and the book must be judged by the way in which it presents theory to students. The first point which strikes a reader is the great looseness of terminology. In the first two or three pages tension, tensile force, pull and axial force are all used as equivalent, which may not be wrong, but is confusing. Also a compression is a shortening, a sliding (in shear) is a detrusion, and the word strain does not appear in the volume, which is unusual. Young's modulus is termed throughout *the* modulus of elasticity; the condition that lateral contraction is unhindered is not explained. The coefficient of rigidity is referred to (p. 38) as the "modulus of elasticity for shear," but the relation of E and G is not discussed until p. 465. The volumetric modulus is described on p. 467, but these are the only elastic coefficients mentioned.

The author has an aggravating way of describing a thing at first very crudely and inaccurately, but without any reservations, giving a revised statement much later on and a further revision later still, and this in the case of quite simple matters. Take, for instance, the treatment of shear. On p. 38 the author takes as the typical example of shear a force P acting at the end of a T-shaped short beam. This is, of course, a case of shear and bending, and the rectangular elevation of the beam would not become a rhombus as the author states. The shear on horizontal planes is not referred to, and the unit stress is given as P/a without any caution that it is not uniformly distributed; and it is from this complex case that he deduces, as if it were a simple shear, the coefficient of rigidity. All this is inaccurate and confusing to students. It is not until p. 264 that it is explained that shear on one pair of planes is accompanied by an equal shear on a pair of planes at right angles, and on p. 465 the author goes back to representing shear as a single couple on a pair of parallel planes. In both Figs. 15 and 181 the deformation is so drawn that a student would infer a change of volume in shear, and nowhere, so far as can be found, is the constancy of volume in shear referred to. On p. 14 the end of a beam strained by a couple is used as an illustration of shear. The unit shearing stress is given as P/a, which is only the mean stress, and it is added that the bar will shear off when P/a is "equal to the ultimate shearing strength of the material," which is not the case. Can a more misleading statement for a student be imagined than (p. 14) "tensile and compressive stresses usually act parallel to the axis of a bar, but shearing stresses at right angles to it"? or this statement, p. 363, "it is best to consider shear as a signless quantity"? All these matters are elementary, and they are not so much wrong as slovenly and confusing—and similar faults occur constantly.

When the elastic limit is exceeded, the strains increase faster than the stresses. "Therefore the elastic properties of a bar are injured when it is stressed beyond the elastic limit." It would not be exact, but it would be more accurate, to say that the elastic properties are improved by straining beyond the elastic limit. "Accordingly it is a fundamental rule that the unit stresses should not exceed the elastic limit." The large deformation in ordinary materials beyond the elastic limit is the primary reason for limiting stresses to the elastic strength. It would be undesirable for a bridge to deflect several feet. The elastic limit is always assumed by the author to be a definitely fixed stress, and its variation under variation of loading is never referred to.

"The stresses are usually computed for dead and live loads separately regarding each as a static load. The live load, however, really produces greater stresses than the computed ones."

The live load undoubtedly may cause rupture when an equal dead load would not, but the author's statement is extremely doubtful, and the question is one of the most fundamental in applying the rules of strength of materials, and should on no account be slurred over in a text-book. The account of Wöhler's fatigue experiments (p. 352) is very brief and imperfect. American bridge builders have never fully accepted Wöhler's results, and have been disposed to explain the smaller working stress in members subject to great variation of stress as justified by the effect of impact. Practically it does not matter much whether the reduction of the working stress is termed an "allowance for impact" or "an allowance for fatigue," but it is a fundamental point, and the author's treatment of it on p. 358 will not much help a student. The author's theory that a live load produces more stress "because it is applied quickly," and the statement that the dynamic stress T can be expressed in terms of the static stress S by the relation $T = \phi(t)S$, where $\phi(t)$ is a function of the time of application, will require much more investigation before it is accepted. The effect of variation of stress in inducing fatigue, the effect of impact or of loads which have kinetic energy before deformation begins, and of loads which are unbalanced so that they acquire kinetic energy during deformation, require

careful discrimination. The effects should not be lumped together as due to suddenness.

A good deal of space is devoted to what the author terms "true stresses." He takes the well known strain equations $E\epsilon_1 = S_1 - \lambda S_2 - \lambda S_3$, &c., and, because $E\epsilon_1$ is of the same form as stress in terms of extension, he calls $E\epsilon_1$ the "true stress" due to the "apparent stresses" S_1, S_2, S_3. This is to use the term "stress" in a totally new sense. The real stresses which balance the external forces are only "apparent stresses"; an imaginary stress which is greater is the "true stress." It is impossible here to follow the author to the curious results he arrives at, which involve a revision of all the ordinary formulas of strength. It is not difficult to see from what point he has drifted. He throughout implicitly assumes that the condition of security in a structure depends on the maximum stress. He nowhere discusses the other views which have been taken. Now one of these is that security depends, not on maximum stress, but on maximum strain. What the author does with his equations is to make security depend on the maximum strains ϵ_1, &c.; but this does not justify him in calling $E\epsilon_1$ a true stress.

A HANDBOOK OF FLOWER BIOLOGY.

Handbuch der Blutenbiologie. Vol. iii. Part ii. By Ernst Loew, assisted by Otto Appel, completing the work commenced by Paul Knuth. Pp. v+601. (Leipzig: Wilhelm Engelmann, 1905.) Price 18s. net, in paper cover.

THE work which the late Prof. Knuth projected and commenced a "Handbook of Flower-Biology," to replace Hermann Müller's "Fertilisation of Flowers" is now complete. It runs as follows:—vol. i., an advanced text-book of flower biology; vol. ii., an account of observations made in Europe (two parts); vol. iii., an account of observations made outside Europe (also two parts).

Ernst Loew, who, after Knuth's death, undertook the completion of the work, appends to the last part a review of the collected extra-European observations.

There can be no doubt of the preeminent fitness of Dr. Loew for his task; but the result on close criticism is found just a little disappointing on account of omissions, *e.g.* Willis's observations on Phacelia, Monarda, and Ixora, and Keeble's on Loranthus, incorrect citations at the rate of one per page in the literature-list—an imperfect index, far too many printer's errors, and illustrations not always, I believe, drawn from the living flower.

Dr. Percy Groom (NATURE, vol. lxxi. p. 26) remarked on omissions and printer's errors in reviewing the preceding part of this work.

Of the body of the work, it is to be said that, besides abstracting all pertinent publications that have fallen into Dr. Loew's hands, it gives to the world a considerable number of original observations made by Knuth in Java, Japan, and California, and a few of Loew's made in the Berlin Botanic Garden, and that the names of North American insects have been subject to a revision by Prof. Robertson, of Carlinville, Illinois.

Of the review, it is to be explained that it centres on a discussion of the fertilising agents in countries outside Europe. I greatly appreciate the vast amount of labour which Dr. Loew has put into it. He could hardly have made greater use of the fragmentary material to hand. But the account of fertilisation in the tropics wants atmosphere; it is such as a man would write who had no particular experience of their vegetation. Twelve pages of the review are given to this account: first, Dr. Loew borrows from Prof. Warming a description of the vegetation of Lagoa Santa, in Brazil; then he goes on very successfully to discuss the part which birds play in fertilising flowers. In the place of the description of Lagoa Santa, one had hoped to find a more general description of tropical seasons. Nearly twelve pages are given to an account of fertilisation in New Zealand and the Antarctic islands—chiefly to a comparison of Arctic and Antarctic flowers, wherein Loew sees less agreement than does Delpino. Four and a half pages are given to South Africa with Madagascar—an ill-assorted union, three to the cactus region of N. America, six to the Arctic region including Spitzbergen, and twenty-six to the forest belt of N. America. I have here set down the number of pages devoted to each region because they rightly indicate the proportion in which the regions have been studied.

In dealing with the forest belt of N. America, Loew depends, of course, on Robertson's excellent work; there alone he really finds facts enough to enable him to work in the statistical methods which he has used so extensively in his writings regarding European flowers.

A time will come when the botanists of North America ask for a handbook of North American flower biology. Loew's work shows how far from readiness is material for it, and how very much further from readiness is material for a handbook of flower biology for any other part of the world. Until we get such handbooks, Loew's volume of Knuth's work will remain very useful on account of its suggestions, its references, its information, and especially as a companion in travel. I. H. B.

A FRENCH BOOK ON SPORT AND TRAPPING.

Chasse, Élevage et Piégeage. By A. de Lesse. Encyclopédie Agricole. Pp. xii+532; illustrated. (Paris: J. B. Baillière and Son, 1905.) Price 5 francs.

THE volume before us is one of a series dealing not only with subjects pertaining to agriculture in its proper and more restricted sense, but likewise with practically everything connected with country life which has any bearing at all on that pursuit. In the present instance, the subject of the trapping and snaring (*piégeage*) of animals, which, in the case of noxious species is, of course, a matter of considerable importance to the agriculturist, serves to establish a connection between sport (especially in the French sense of that term) on the one hand and agriculture on the other, and thus justifies the inclusion of the volume in the series. In connection

with the subject of trapping and snaring, we may take occasion to remark that the agitation which has been set on foot in this country against traps of an unduly cruel nature (indeed, against "gin-traps" of all kinds) does not appear to have reached the other side of the Channel, or, at all events, does not seem to have had any effect there. For in the present volume there is a cut of an unfortunate falcon ensnared in one of the abominable pole-traps, without a word of condemnation of snares of that description (unnecessarily cruel from the fact that they are in many cases only visited at long intervals).

The volume commences with a series of chapters pointing out the commercial importance of "la chasse," first as a source of revenue to the State, then as a source of food-supply, next in connection with rendering unfertile tracts profitable, and finally in relation to the rural population. The second section of the volume is devoted to game protection and the natural and artificial rearing of game birds, in the course of which the English and French methods of pheasant breeding are contrasted and their relative merits compared. Sporting dogs—other, of course, than hounds—form the subject of the third section, which is illustrated with a number of cuts (not by any means always of the best) of some of the chief breeds, and the manner of training dogs for their special duties. Then comes a dissertation on the various methods of destroying animals commonly classed as injurious to the game-preserver and the agriculturist, in the course of which, as already mentioned, every kind of trap and gin, no matter how cruel, is described in detail, while the reader is also instructed in the various methods of employing fire-arms and poison for the same end. The more legitimate forms of sport, including, however, small-bird-shooting and rabbit-netting, together with an account of the legislation connected with the subject, form the concluding sections of the volume. The whole subject of "la chasse" or "le sport" is viewed so differently by our French neighbours and by ourselves, that it is somewhat difficult to give an unbiased opinion on the merits of the volume before us. Probably, however, it is thoroughly well suited to the class of readers for whom it is specially intended, although we cannot but regret that an attempt was not made to inculcate more humane views in the matter of the destruction of so-called noxious animals.

R. L.

OUR BOOK SHELF.

Ergebnisse und Probleme der Elektronentheorie. By Prof. H. A. Lorentz. Pp. 62. (Berlin: J. Springer, 1905.)

THIS book contains a lecture given by Prof. H. A. Lorentz before the Elektrotechnischen Verein at Berlin, December, 1904, to which certain additions have been made. It is a most interesting semi-popular account of the present position of the electron theory, which is due largely to the author.

The lecturer begins with a short historical introduction, and then goes on to discuss the properties of kathode rays, which, of course, are negative electrons. He describes the methods by which the ratio of the mass to the charge of these rays has been determined, and Kaufmann's beautiful research on the β rays from radium, which, in conjunction with J. J. Thomson's and Abraham's theoretical investigations, has led to the conclusion that the mass of these rays or electrons is entirely electromagnetic in its origin.

The most interesting part of the lecture now follows, where a description is given of the electron theory of the conductivity of metals. The beginnings of the electron theory of metallic conductivity we owe to Weber and Kohlrausch, and its recent developments to Riecke, Drude, and J. J. Thomson. Lorentz here adopts J. J. Thomson's view, that the conductivity of metals is entirely due to the presence in them of freely moving negative electrons, and that the positive electrons are practically fixed, and so do not contribute to the conductivity. Riecke and Drude have so far supposed that both the positive and negative electrons move. The lecture contains an interesting discussion of the special difficulties of these rival hypotheses, neither of which has yet been made to fit in with all the facts.

According to the electron theory of metallic conduction, the electrons move about between the metal atoms so that they are practically in the gaseous condition and the results of the kinetic theory of gases can be applied to them. On these assumptions the ratio of the conductivity for heat to the electrical conductivity can be calculated, and the result is that

$$\frac{k}{\sigma}=\frac{4}{3}\left(\frac{\alpha}{e}\right)^2\mathrm{T},$$

where k=heat conductivity, σ=electrical conductivity, T=absolute temperature, e=charge carried by one electron, and α=the gas constant. According to this equation, k/σ should be the same for all metals and proportional to the absolute temperature. The experimental results so far obtained agree on the whole very well with these conclusions, and form a striking confirmation of the general truth of the theory. The observed absolute value of k/σ also agrees fairly well with that calculated by means of the formula just given.

The electron theory also gives a fairly satisfactory explanation of the phenomena of thermoelectricity and contact potential difference, but it is very difficult to reconcile completely with the facts on the Hall effect. H. A. Lorentz's lecture shows that many problems of the electron theory still await a solution, but it also shows the immense progress which has recently been made, and suggests the idea that very soon nothing but ether and electrons will be retained in our conception of the physical universe.

H. A. WILSON.

Die elektrischen Bogenlampen, deren Prinzip, Konstruktion und Anwendung. By J. Zeidler. Edited by Dr. G. Benischke. Pp. x+143. (Brunswick: Friedrich Vieweg und Sohn, 1905.) Price 5.50 marks.

THE book published under the above title forms the sixth pamphlet of "Elektrotechnik in Einzel-Darstellungen." The author divides the contents into four parts. In the first one he shows great ingenuity in classifying lamps; he also explains the actions of series, shunt, and differential arcs, and describes the precautions which are necessary to ensure steady burning.

In the second part we find the constructions of various types of arc lamps, the sizes of carbons to be used, the advantages and disadvantages of flame and enclosed arcs, and an article on inverted lamps.

The third part deals with the distribution and calculation of light. It describes the construction of polar and Rousseau curves, the meaning of hemispherical intensity, the power-factor of alternate current flame

arcs, the calculation of light for interior and exterior places, and concludes with tables giving the reflecting powers of various surfaces, and the horizontal illumination required for different places.

The last part illustrates the construction and application of auxiliary plant, including steadying resistances, choking coils, transformers, safety appliances, &c.

The book is intended chiefly for students. As such it might be improved by including a little more of the theory of the arc, of which the author says practically nothing. Very few engineering students will find sufficient time to study works such as "The Electric Arc," by Mrs. Ayrton, unless they make the study of arc lamps their speciality.

The second part will form a good advertisement for the A.E.G. Company's lamps, as most of the diagrams represent designs made by this firm. But although it is quite easy to deduct the principles of action of other lamps from the diagrams given, one does not like to see in a text-book the productions of one manufacturer only, as it reduces the work almost to a catalogue. Of great interest is Foster's hot-wire arc lamp, although its commercial value has yet to be proved.

The most useful part of the book is the third one, which will be welcomed by many students who are able to read German. Also the fourth part contains much useful matter.

The book is practically free from printer's errors. The few which occur may easily be detected by even the most elementary reader.

Taken as a whole, the pamphlet will be found a useful addition to electrical engineering literature.

H. BOHLE.

Transactions of the South African Philosophical Society. Vol. xv. Part v. Catalogue of Printed Books, Papers, and Maps relating to the Geology and Mineralogy of South Africa to December 31, 1904. By Miss M. Wilman. Pp. 283–467. (Cape Town, 1905.) Price 12*s*. 6*d*.

THIS excellent bibliography represents months of patient labour spent on a bewildering but necessary task, and now happily carried to a successful termination. The whole civilised world appears to have had something to say on African geology. The labour entailed in drawing up these lists, which easily supersede all others, will therefore be obvious. The author has had, indeed, to exercise considerable acumen in discarding numerous papers, &c., often containing mere references to geology, in order to bring the lists even within their present compass. As it is, a few works, since they are mentioned in earlier lists, have had to be included, although they add little to geological literature. The title is generally sufficient to warn the inquirer.

Part i. deals with works on the general geology of South Africa, part ii. contains a list of geological maps, while part iii. is exclusively devoted to works on meteorites. The print is clear, and the names of authors are distinctly marked in Clarendon type.

W. G.

Problems in Practical Physics. By F. R. Pearson, M.A. Pp. 30. (Edinburgh and London: Oliver and Boyd, 1905.) Price 6*d*.

THESE problems are intended to accompany practical work in a laboratory, and should serve to give practice in working out results. The subjects on which examples for solution are set include the parts of physical science studied in a first year's course. Teachers of mathematics may find the booklet useful, as it will provide interesting applications of simple mathematical principles to practical problems coming within simple laboratory experience.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Terminology in Electro-physiology.

MY attention has been directed to a letter in your columns (p. 5) commenting upon the ambiguous use made in physiological literature of two opposed terms, "negative" and "electropositive."

To me also it seems a misfortune that this ambiguity has ever arisen, nor do I see any necessity why it should be allowed to persist. There is no obvious reason why, in scientific papers, the terminology of the physicist should not be adhered to. The "negativity" of a point is detected by means of the current which flows towards it, or tends to flow towards it, through some form of external indicator connecting it to the point which is spoken of as "positive." These terms, and these terms alone, adequately express the facts of all the experimental observations made. Any other terminology differing from this is necessarily based upon some inference as to the mode of causation of the currents detected. Since it is the causation of these currents which is the main crux of the research work undertaken in this subject, the admission of such an inference seems a certain road to the confusion of ideas.

In all cases where an effort has to be made to carry home to an audience the more exact ideas existing in the author's brain, in all cases where parables are not only admissible but necessary, I think the terms suggested by Dr. Waller are of extreme value. Anyone acquainted with the explanatory use he has made of them in his "Animal Electricity" will agree. Whilst sincerely admiring his profoundly clever method of administering large doses of knowledge by means of this and similar parables, I have observed two things. In the first place, that duller wits, hugely mistaken, sometimes assess his knowledge as mainly one of parables. In the second place, that less expert persons are apt to carry conclusions derived from parables to a bitter and unjustifiable extremity.

Sheffield University. J. S. MACDONALD.

The Leonid Meteors, 1905

THE remarkable displays of these meteors observed in 1903 and 1904 may naturally raise the expectation as to whether the approaching Leonid epoch will exhibit an abundant fall of shooting stars. Observers, it is true, will have to contend against the impediment offered by the light of the gibbous moon; but, it may be remarked, this can only affect the smaller class of meteors, as the brilliant apparitions of 1866, 1867, and 1886 were witnessed at a similar phase of our satellite.

The Leonid events of the past two years afford striking illustrations of the meteoric cycle of nineteen years, being associated respectively with the Leonid meteor displays of 1865 and 1866, and the present November gives ample promise of furnishing another example of the same period.

Unlike the Leonid falls of 1865 and 1866, that of November 14, 1867, was brilliantly reproduced on the first completion of this cycle on the morning of November 15, 1886, the spectacle being of extraordinary splendour (NATURE, vol. lxi., p. 491).

The Leonid maximum of 1905 will fall on the night of November 15, and, according to calculations by the present writer, will be visible both over Europe and America. The shower will be of second-class order, that of 1866 being regarded as of first, and will commence early in the night, the first maximum occurring on November 15 11h. G.M.T. From this hour up to about three o'clock on the morning of November 16 the Leonids will probably gradually increase in numbers, the second maximum of the night becoming due on November 15, 15h. 10m. The final maximum on November 15 occurs at 21h., and will consequently be visible to American observers only.

Dublin. JOHN R. HENRY.

Border occasionally seen between Light and Dark Regions on Photographic Plates.

THE reason mentioned by Sir Oliver Lodge (p. 5) for the border seen between light and dark regions on photographs is not the only one. In the denser regions of a negative the developer gets more exhausted or restrained than in the thinner regions, and this affects the adjacent parts. At the junction of a dense and a thin area the edge of the thin part is made thinner by the restraining compounds (bromide, oxidised pyrogallol, &c.) derived from the denser part, while, on the contrary, the edge of the denser part is made denser by the less exhausted developer flowing from the thin area. This effect is apt to be the more marked when the developer is already well restrained, as by staleness or the addition of much bromide.

Cambridge, November 4. F. J. ALLEN.

THE explanation of a well known phenomenon in photography, given by Sir Oliver Lodge in his letter to you last week (p. 5), does not take into consideration the following facts:—

(1) The "perceptible difference in thickness" between the acted-on and unacted-on portions of a negative is only perceptible to our unaided senses when certain developers are employed containing substances which act powerfully on the gelatin. Most modern negatives certainly have no *perceptible* difference in thickness, certainly not enough difference to give rise to so marked an effect as that referred to.

(2) The difference in thickness is most marked in the "carbon" transparencies from which many enlarged negatives are made. Here it can be both seen and felt; in the other case it cannot. We might therefore expect this cylindrical lens effect to be most marked when using such a transparency, but the careful comparison of a number of enlarged negatives made in these two methods reveals not the slightest difference between them.

In my own mind I have always accounted for the phenomenon in the following way:—The sensitive film ordinarily can only be approached by the developer from its outward face, hence the action over an area where the light action has been the same is uniform. But if that area is bordered by one where there has been little or no light action, the developer absorbed by such parts is not spent in doing any or much work in those parts, and, so far as any lateral diffusion is concerned, is practically fresh developer. Hence the borders of an exposed portion, where it comes against an unexposed portion, are attacked by fresh developer diffusing both from the front and from the unexposed part, and we should therefore expect to find a border line of greater density there, as in fact we do. For a similar reason we should expect to find a less dense line on the border of the more transparent portion, as is the case, though it is not often so noticeable as the former.

That this is the true explanation is, I think, made manifest by the fact that the line in question can be quite easily distinguished on plates exposed in Spurge's actinometer, where there is certainly no opportunity of a "cylindrical lens effect," and especially when development has been pushed far. R. CHILD BAYLEY.

20 Tudor Street, London, E.C., November 6.

The Use of Gasoline in Chemical and Physical Laboratories.

EXPERIMENTAL work has so thoroughly established its claims to a reasonable share in the curriculum of every secondary school that very few schools are now without proper laboratories. No inconsiderable number of these schools are, however, beyond the limits of the ordinary gas supply, and the question of providing a substitute for coal-gas has presented no little difficulty. The matter became urgent some time ago at the Llanberis Intermediate School, mainly for heating purposes, but also for lighting. Investigation seemed to point to two possible substitutes—acetylene and gasoline. Both have been used, but not to any very large extent, in this country. An account was given in the *School World* for January 1902, of the use of acetylene in Felsted School.

For a small installation, where light is the first consideration, it would probably be admitted that acetylene is highly satisfactory, but even for lighting the use of mantles has rendered gasoline a very severe rival. The problem is different when heat is the chief factor. In most cases of schools the gas is required to meet both demands, and gasoline seems to possess the advantage.

The questions for consideration are cost and efficiency.

In reference to cost, estimates were obtained to supply the chemical and physical laboratories and to light the whole building, and showed that the initial cost of plant and fitter's work would be about fifty per cent. higher for acetylene than for gasoline, and the estimated cost of maintenance for the former was also much higher.

Efficiency may be considered under the following heads:—(*a*) The relative simplicity of the generating plant; (*b*) the ease of manipulation; (*c*) the nearness to which the gas approaches in use to coal-gas; (*d*) the risk of explosion.

(*a*) The plant used in the Llanberis School was supplied by the Walworth Manufacturing Co., of Boston, U.S.A., and consists essentially of three parts:—(1) A large shallow cylindrical copper tank, holding 250 gallons, buried some 30 feet or more from the building, which is filled with gasoline through a pipe and closed air-tight by a screw cap. Two other pipes, an inlet and outlet, are fitted into the top of the tank and pass under ground to the cellar of the building. (2) In the cellar a pump, worked by a weight on pulleys, forces air through the inlet pipe on to the surface of the gasoline in the tank. Evaporation is rapid (gasoline boiling from about 35° C. to 70° C.), and the mixture of vapour and air is driven through the outlet pipe into (3) an automatic mixer, by which a definite and known amount of air can be added, so that the proper proportion for burning may be constantly maintained. The whole plant is extremely simple, and was easily put up by a local gas-fitter under my direction.

(*b*) It requires very little attention. The weight has to be wound up about once a week; the mixer adjusted, by moving a small wheel along a rod, about once every two or three months; and the tank filled about every twelve or eighteen months. The frequency of the recurrence of these operations clearly depends on the size of the plant relative to the demands upon it.

(*c*) The burners differ slightly from the ordinary coal-gas bunsens, but give an excellent flame for ordinary laboratory purposes. The most noticeable difference is that the flame is more easily blown out. This gives a little trouble with an ordinary foot blowpipe, but a slight modification, which I hope to carry out, suggested by my friend Mr. B. B. Turner, of Storrs Agricultural College, Connecticut (who has used gasoline for some years, and who brought it to my notice), will probably get over the difficulty. The plant supplies enough gas to light the whole building as well as for laboratory purposes.

(*d*) The risk of explosion is very slight, as any escape is at once detected by the strong smell, and the limits of explosion are narrower than those of coal-gas and very much narrower than those of acetylene. The absence of any heating arrangements to aid the evaporation, such as are proposed by some makers, considerably reduces the risk of explosion. J. R. FOSTER.

THE AEGER IN THE RIVERS TRENT AND OUSE.

HAVING had an opportunity of witnessing the bore, or aeger as it is locally called, in the River Trent at Gainsborough during the recent high equinoctial tides, which did so much damage all along the east coast, I send you the following description, which may interest some of your readers, more especially as I am not aware of any trustworthy account of this bore that has yet been published.

The Trent is a tributary of the Humber, and joins that river about 16 miles above Hull and 40 miles from the North Sea. The width of the Trent at the junction is from 2500 feet to 3000 feet at high water, diminishing to 700 feet $1\frac{1}{2}$ miles from the

junction. This wide space is encumbered with a mass of sand banks. The width of the Humber below the junction averages about 4500 feet, and this channel also feeds the Ouse, which is a continuation of the Humber. This width is double that of the Trent and Ouse combined. The rise of ordinary spring tides at Trent mouth is 15 feet, increasing at equinoctial tides to 19 feet. The tide has a run of 47 miles up the Trent, and reaches to 87 miles from the North Sea, the flood lasting three hours and the ebb nine hours.

The bore, or aeger, is caused by the check of the tidal flow through the shoal water of the sand banks and the contraction of the waterway, the tidal current overrunning the transmission of the foot of the wave. It first assumes a crest somewhere between Burton Stather, 3 miles from the mouth of the Trent, and Amcotts, 2 miles further on, depending on the condition of the tide, the water rising almost simultaneously 3 feet. In ordinary spring tides the bore does not extend more than 7 or 10 miles above Gainsborough. In high spring tides it diminishes to 1 foot in height at Torksey, 35 miles from the mouth of the river, and then gradually dies out.

FIG. 1.—The Aeger in the Trent.

The bore was to be seen under exceptionally favourable conditions on September 30 and October 1 last, being the second and third days after the new moon. The tides were laid down in the Admiralty tide tables for the Humber as the largest of the year. The moon was in perigee on September 29, and had 11·21 degrees south declination. The wind was from N.E. to N.W., a direction which brings the largest tides, and was blowing at Spurn with a force of from 6 to 7. Inland the force was only about 3 on the Beaufort scale. There was a limited quantity of fresh water running down the river, the velocity at low water being 2 miles an hour. The depth in the channel between Gainsborough and the Humber is now about 6 feet, but there are several shoals with not more than 2 feet to $2\frac{1}{2}$ feet over them. The tide was exceptionally high, rising in the Humber at Hull nearly 3 feet higher than ordinary spring tides, and within 10 inches of the record tide of March, 1883.

The bore could be heard approaching about half a mile from the place of observation, and passed with a crest in the middle of the river of from 4 feet to $4\frac{1}{2}$ feet extending across the full width of the river, which is here about 200 feet at high water. At the sides the breaking wave rolled along the banks 6 feet or 7 feet high. The crest was followed by five or six other waves of less height, terminating in a mass of turbulent broken water for a distance of 100 yards. The velocity of the wave, as nearly as it could be measured, was about 15 miles an hour, the current running up after the bore had passed at the rate of $4\frac{1}{4}$ miles an hour, and at its maximum, about half flood, 5 miles an hour. The tide rose 4 feet in the first four minutes after the arrival of the bore, 5 feet in the first half hour, and 8 feet in two hours, when it attained its maximum height and commenced to fall; but the tide continued running up the river for another hour after this, at the reduced velocity of 2 miles an hour. There were some steamers and barges lying at the wharves, and a row-boat in the middle of the river. These rose with the wave and suffered no harm.

These bores were considered by the men on the river as fair specimens of those which come with high tides, and as never exceeded in height to any extent. When the river is full of fresh water and the ebb is heavy the bore is less pronounced, and does not show at all on neap tides. It was reported that at Owston Ferry, which is 8 miles nearer the Humber than Gainsborough, the crest of the aeger was 8 feet, but this was probably at the side of the river. A boat which was in the middle of the river when the wave came was for an instant completely out of sight of a spectator on the bank.

The photograph from which the illustration is taken is by Mr. E. W. Carter, of Gainsborough, and is copyright.

In the Ouse during spring tides there is a less pronounced bore. In ordinary spring tides it commences at a shallow reach in the river at Sand Hall, 2 miles above Goole, attains its greatest height 4 miles above Selby, and then gradually dies out. The crest of the bore is from 2 feet to 3 feet, and the breaking wave at the sides 6 feet or 7 feet. In summer, when the ebb current is low, the aeger reaches Naburn with a crest 1 foot 6 inches high. Since the improvement of the channel of the river below Goole these aegers have become smaller.

W. H. WHEELER.

SURVEY OF THE SIMPLON TUNNEL.

WE have appreciated many of the difficulties the engineers encountered in the construction of the Simplon Tunnel and have offered our congratulations on the successful completion of the work. But the difficulties that have been most readily apprehended have been those arising from the outburst of water from the hot springs in the track, the high temperature, and the mechanical boring and removal of the rock. In the happy completion of a task of great magnitude, which at one time threatened to end in a catastrophe, people are apt to forget the onerous preliminary work necessary to set out the line of the tunnel, to arrange the gradient so as to provide not only for efficient drainage at either end, but to secure the continuity of the separate tunnels at the point of junction, and so render it possible to work simultaneously at both ends. We are therefore glad to see an article by Prof. C. Koppe in *Himmel und Erde* for August [1] bringing these matters forward, and making us familiar with the work which has

[1] "Die Vermessungs- und Absteckungs-Arbeiten für den Simplon Tunnel"

been so efficiently carried out by Prof. Rosenmund of Zurich.

Before the work of boring and perforation can be begun, there are three elements which have to be determined with an accuracy which must be greater in proportion to the difficulties of construction. These are the direction, the length, and the altitude above sea-level. Assuming that the places of entrance and exit of the tunnel have been marked by suitable pillars, the determination of these three elements begins; and that of the level is the least difficult, because the surveying engineer trusts to direct measurements. By the aid of accurate levelling instruments, it is possible to derive the difference in altitude of two stations 50 kilometres apart with no greater error than 3 cm. This is effected by the use of the levelling staff, which is read by means of an accurate level, the staff being placed vertically at two stations a convenient distance apart, and the sum of the differences of each pair of readings being taken. The surveyor apparently trusts entirely to the accuracy with which his theodolite can be levelled. Several determinations of the difference of level of the two ends of the tunnel were made, but between the two last there was a discrepancy of only 2 cm., a more than sufficient degree of accuracy. The actual difference of level between the two ends was 52.439 metres.

The second element, that of the length of the tunnel, is to be derived indirectly from triangulation, the length being reckoned from the same points that have served for the determination of difference of level, and, as a matter of fact, these points are at some distance from the actual openings. A base line being given, the construction and the solution of the triangles present little difficulty, for here great accuracy is not required, and the probable error that Prof. Rosenmund was content to leave in his work amounted to ±0.7 metre. The distances measured are as follows:—

	metres
The length between the columns marking the axis of tunnel...	20,091·33
Distance of northern column from tunnel opening	317·78
Distance of southern column from tunnel opening	44·84
Actual length of tunnel	19,728·71

The third element, that of direction, at all times presents some difficulty, and, in the case of mountains, where local attraction enters as a disturbing factor, the problem requires very delicate treatment. In a tunnel 20 kilometres long, an error in direction of one minute, which is usually the limit of accuracy sought in technical work, would produce an error of 6 metres, and the tenth part of such an error would be too great. Recourse is necessarily had to triangulation, and the angular measurements must be made with the greatest care. Well-defined signal posts must be erected to mark the angles of the selected triangles, and the points of reference in these pillars defined with the utmost accuracy. The form which Prof. Rosenmund preferred consisted of cylindrical towers of brick about eight feet high, of which the axis was an iron tube the upper edge of which reached the top surface of the tower. A wooden pole carried this iron tube vertically upwards, and the whole was surmounted by a conical tin covering, the highest point of which was vertically over the centre of the iron axis. Eleven of these piers were erected, and when signals were made from any pillar the conical top was removed, and the theodolite was placed centrally over the middle of the iron tube in the cylindrical tower, which afforded a solid support for the instrument and permitted accurate observation of the other stations. With the care exercised, it might have been anticipated that the sum of the angles of any triangle would differ from 180° by the known amount of the spherical excess, within the errors of observation. But the discrepancies were much larger, varying from 4 to 8.5 seconds, and these deviations could be explained only by attributing to the mountain an attractive force, which sensibly displaced the direction of the plumb-line. In other words, the theodolite was not placed horizontally. The amount of the deviations from the vertical, with the azimuths in which they occur, is shown in the following table:—

Station	Deviation from vertical	Azimuth
	″	° ′
North point of axis... ...	13·9 ...	248 26
Oberried	19·1 ...	195 12
Birgischwald	16·4 ...	188 5
Rosswald	23·6 ...	262 56
Spitzhorn	17·5 ...	314 18
Monte Leone...	0·0 ...	0
Hullehorn	8·2 ...	244 3
Seehorn	5·6 ...	75 28
Alpe Wolf	11·4 ...	36 46
Genuina	9·1 ...	192 3
South point of axis... ...	5·8 ...	139 11

Assuming these deviations from the vertical to arise from the attraction of the mountain mass, an hypothesis which was confirmed by rigorous astronomical observation, it was found possible to reduce the closing errors of the triangles very materially. The solution of the whole network of triangulation showed that the tunnel's axis was fixed with a probable error of ±0″.7, and that the direction of the tunnel could be fixed with sufficient accuracy by pointing the telescope, placed on one of the piers at the entrance of the tunnel, to any other signal tower, and revolving the telescope through a known angle.

It would be interesting to enter into the details by which the path of the tunnel was checked as the work progressed, more especially as curious refractive effects, akin to those seen in "mirage," occurred to render the observations somewhat difficult and uncertain. These disturbing effects were more noticeable when observing towards the north end of the tunnel, where the difference of temperature between the internal and external atmosphere was greatest. On the southern side, the external air being warmer than on the north side, the "mirage" was not so conspicuous. But we have only space to refer to the degree of success which resulted from the care bestowed on this difficult undertaking—a success which could not be adequately tested until the junction of the engineering parties in the middle of the tunnel was effected. To take the three elements in order, it was found that the level agreed within 0.1 metre of the calculations. The length as measured differed 2 metres from the calculated value, but, as mentioned, this was a factor in which great accuracy was not needed, because, if the direction were given correctly, it was only necessary to continue the borings until the engineers from the south and north sides met in the middle. The direction was most satisfactory. The wall of one tunnel was absolutely continuous with the wall of the other; an attempt was made to compare the opposite walls of the tunnel for confirmation, but this attempt was frustrated by a projecting piece of rock. No better result could have been anticipated, and the utmost credit attaches to Prof. Rosenmund and his assistants.

W. E. P.

BURSARIES AT THE ROYAL COLLEGE OF SCIENCE.

SCIENCE scholars selected from the whole of Great Britain for their ability and promise, maintaining themselves on 17*s.* 9*d.* per week, were this year saved from much privation by secret gifts of small bursaries—see the subjoined audited account. I have no right to ask for help from the generous men who helped me last year, but I have all the sturdiness of a chartered beggar—I ask in a good cause.

It was originally intended that these bursaries should be given only to such National Scholars as required assistance, but some of the subscribers have given me power to assist other students of the college. Also one of the two City Companies has given me power to grant an occasional bursary of more than ten pounds. It is understood that every student is morally bound to repay this money to the fund at some future time.

JOHN PERRY.

October.

ROYAL COLLEGE OF SCIENCE.

BURSARIES 1904–1905.

BALANCE SHEET.

Moneys Received and Paid by Prof. Perry.

RECEIVED	£ s. d.	PAID	£ s. d.
Balance from last year	£24 2 0	*Dec.* 16 *to Feb.* 28. 25 students received half bursaries, £5 each ...	£125 0 0
August, 1904. Dr. Sprague	20 0 0		
R. Kaye Gray, Esq..	10 0 0		
September, 1904. Prof. J. Perry (slide rules)	1 6 0	*January* 31, 1905. 1 student received a half bursary of £7 10*s.*	7 10 0
November, 1904. Returned half bursary	5 0 0		
Sir Andrew Noble...	10 0 0	*February* 15. 1 student received the second half of his bursary	5 0 0
December, 1904. The Drapers' Co. ...	100 0 0		
Prof. J. Perry (slide rules)	2 19 0	*March* 24 *to June* 15. 22 students received second halves, £5 each...	110 0 0
January, 1905. J. Drinkwater, Esq.	1 1 0		
The Goldsmiths' Co.	100 0 0	*June* 5. 1 student received second half ...	7 10 0
April, 1905. Prof. J. Perry (slide rules)	3 11 0	2 students refused their second halves	
		Balance in hand	22 19 0
Total	£277 19 0	Total	£277 19 0

Twenty-three students received 10*l.* each, two received 5*l.* each, and one received 15*l.*

Audited and Signed by JOHN W. JUDD.

Dated June 22, 1905.

DR. RALPH COPELAND.

ASTRONOMERS will have learned with profound regret that Dr. Ralph Copeland, Astronomer Royal for Scotland, died on October 27 at the Edinburgh Observatory in the sixty-eighth year of his age. Dr. Copeland enjoyed a more varied life than generally falls to the lot of astronomers. The love of travel and adventure seemed with him to be only second to his desire to advance the interests of astronomy.

Born in Lancashire, he early went to Australia, where, on the somewhat uncongenial soil of a sheep-run, he acquired his first telescope and diligently used it. Then he was for a short time attracted by the excitement of the gold diggings, but he forsook these to return to England, having determined to devote himself to astronomy. He matriculated at the University of Göttingen, and enjoyed the advantages of instruction from Prof. Klinkerfuss. For a while he took part in the routine work of the Göttingen Observatory, but the love of adventure still possessed him, and we find him in 1867 taking part in an expedition to explore the east coast of Greenland, climbing mountains and otherwise distinguishing himself, so that on his return he was awarded the Order of the Red Eagle by the German Emperor. Shortly after his return to Europe he came to England, and though he was connected with both the observatory of Lord Rosse at Birr Castle and with that at Dunsink, he is better known for his work in connection with both expeditions of 1874 and 1882 to observe the transit of Venus. In the first he was a member of Lord Lindsay's (now Earl of Crawford) unsuccessful expedition to Mauritius, but on the occasion of the second transit he was more fortunate at Jamaica. Before returning to England he spent some time in the Andes of Peru and Bolivia, at altitudes varying from 10,000 feet to 15,000 feet above sea-level, where he carried out a series of researches on the transparency of the atmosphere, the spectra of planetary nebulæ and of certain classes of stars.

In 1889, when the Earl of Crawford presented his instrumental equipment to the Edinburgh University, Dr. Copeland became regius professor of astronomy and Astronomer Royal for Scotland. Here his great work consisted in the re-construction of the National Observatory at Blackford Hill, the full development of the capacity of which was denied him by reason of his failing health. But he still enjoyed opportunities for foreign travel. Norway, India, Spain, were all visited in turn for the observation of solar eclipses. His favourite instrument on these expeditions was a telescope of long focal length.

Dr. Copeland's acquaintance with astronomical literature was wide and intimate, and his collection of works having reference to some departments, such as cometary astronomy, was probably unique for its completeness. In cometary observation he was particularly interested, and it will be recalled that for many years he gave valuable assistance to observers of comets by calculating and circulating ephemerides which he printed at a small press of his own. For some time he gave further encouragement to the science by editing, in conjunction with Dr. Dreyer, the periodical *Copernicus*, devoted to the publication of high-class papers. In fact, Dr. Copeland's activities were by no means limited to what may be called his official duties. He had the gift to interest by his varied knowledge and experience, and used it liberally. He was held in estimation by a large circle of friends and pupils for the picturesqueness with which he imparted his information and his readiness to assist and encourage. The writer is among those who will gratefully acknowledge the charm of his manner and the kindnesses received at his hands.

W. E. P.

CAPTAIN F. W. HUTTON, F.R.S.

NATURAL science has sustained a heavy loss in the death of Captain F. W. Hutton, curator of the Canterbury Museum, president of the New Zealand Institute, and formerly professor of biology and geology in Canterbury College, University of New Zealand. The second son of the Rev. H. F. Hutton, Rector of Spridlington, in Lincolnshire, Frederick Wollaston Hutton was born at Gate Barton in that county on November 16, 1836. He was educated at the grammar school at Southwell, and afterwards at the Naval Academy at Gosport. After serving for three years in the India mercantile marine he entered the Army, becoming ensign in the 23rd Royal Welsh Fusiliers in 1855. He served in the Crimea (1855–6), and saw further active service during the Indian Mutiny, being present at the capture and relief of Lucknow. He was made lieutenant in 1857.

In 1860 he furthered his military studies at the Staff College at Sandhurst, passing the examinations in 1861. At this date geology was taught in the Royal Military College by Prof. T. Rupert Jones, and Hutton, who had taken up the subject with enthusiasm, contributed in 1862 to the *Journal of the Royal United Service Institution* (vol. vi.) an essay on "The Importance of a Knowledge of Geology to Military Men." The importance, strange to say, does not appear to be so fully recognised nowadays. Hutton became captain in 1862, and served for a time as Deputy-Assistant Quartermaster-General at Dublin; but in 1866, having retired from the Army, he emigrated to New Zealand, and devoted himself to the study of natural history, and especially to zoology and geology. In 1871 he was appointed assistant geologist on the Geological Survey of New Zealand, in 1873 provincial geologist of Otago and curator of the Otago Museum, and in 1877 professor of natural science in the Otago University. In 1880 he settled at Christchurch, having become professor of biology and geology in the University of New Zealand, a post which he held until 1893, when he became curator of the Canterbury Museum at Christchurch. He was elected a Fellow of the Royal Society in 1892.

One of his earliest geological papers, a sketch of the physical geology of Malta, was published in the *Geological Magazine* (1866). From this date his work related mainly to the country of his adoption. He prepared official reports on the Lower Waikato district and on the Thames gold-field in 1867, and a report on the geology and gold-fields of Otago (with G. H. F. Ulrich) in 1875. To the Geological Society of London he contributed in 1885 an excellent sketch of the geology of New Zealand, which gave a comprehensive summary of the knowledge attained at that time, and in 1887 he sent to the same society an account of a recent eruption of Mt. Tarawera in North Island. He contributed many other geological papers to the Geological Society and *Geological Magazine*. While distinguished as a geologist, the importance of his researches on zoology was early recognised, and he was elected a corresponding member of the Zoological Society in 1872.

He contributed articles on the fauna and flora of New Zealand, on the land mollusca, the fishes, and the birds, including the extinct moas. Some of these articles were printed in the *Transactions of the New Zealand Institute*, the *Proceedings of the Linnean Society of New South Wales*, in the *Proceedings of the Zoological Society*, in *Ibis*, and other journals.

He was an ardent student of evolution, and among other works issued in 1899 "Darwinism and Lamarckism, Old and New," and in 1902 "The Lesson of Evolution."

After an absence of nearly forty years he paid a visit to this country, and received a hearty welcome from his many scientific friends. He was returning to his home at Christchurch when the announcement of his death on October 27 was received by telegram from the Cape. We are indebted to an obituary in the *Times* for some of the above particulars.

H. B. W.

NOTES.

THE Royal Society has this year made the following awards of medals. The awards of the Royal medals have received the King's approval:—The Copley medal to Prof. D. I. Mendeléeff, of St. Petersburg, for his contributions to chemical and physical science; a Royal medal to Prof. J. H. Poynting, F.R.S., for his researches in physical science, especially in connection with the constant of gravitation and the theories of electrodynamics and radiation; a Royal medal to Prof. C. S. Sherrington, F.R.S., for his researches on the central nervous system, especially in relation to reflex action; the Davy medal to Prof. A. Ladenburg, of Breslau, for his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids; the Hughes medal to Prof. A. Righi, of Bologna, on the ground of his experimental researches in electrical science.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1906, at the anniversary meeting on November 30:—*President*, Lord Rayleigh, O.M.; *treasurer*, Mr. A. B. Kempe; *secretaries*, Prof. Joseph Larmor and Sir Archibald Geikie; *foreign secretary*, Mr. Francis Darwin; *other members of the council*, Dr. Shelford Bidwell, Sir T. Lauder Brunton, Prof. J. Norman Collie, Prof. W. R. Dunstan, Prof. J. B. Farmer, Prof. F. Gotch, Dr. S. F. Harmer, Sir William Huggins, K.C.B., O.M., Prof. E. Ray Lankester, Dr. J. E. Marr, Mr. G. B. Mathews, Mr. H. F. Newall, Sir W. D. Niven, K.C.B., Prof. John Perry, Prof. E. H. Starling, Prof. W. A. Tilden.

AT a meeting of the council of the British Association on November 3 it was decided that, in consequence of strong representations by the local committee, the meeting at York next year shall be opened on Wednesday, August 1, which is earlier than the usual date of the opening meeting.

THE council of the British Association has received a gift of 50*l*. from Mrs. John Hopkinson, to be devoted to some investigation which may be suggested at the next meeting by the committee of recommendations.

THE Paris Academy of Moral and Political Sciences has awarded a prize of the value of 600*l*. to Dr. Calmette, of Lille, in recognition of his work in bacteriology and preventive medicine.

WE regret to see the announcement of the death, at forty-five years of age, of Prof. Walter F. Wislicenus, professor of astronomy in the University of Strasburg and editor of the "Astronomischer Jahresbericht."

A CHRISTMAS course of lectures, adapted to a juvenile auditory, will be delivered at the Royal Institution by Prof. H. H. Turner, F.R.S., on astronomy, from December 28 of this year to January 9, 1906.

DR. MAURITS SNELLIN informs us that he has resigned the directorship of the section of terrestrial magnetism and seismology at the Koninklijk Nederlandsch Meteorologisch Instituut. Dr. Snellin's private address is now Apeldoorn, Holland, and any papers intended for him personally should be sent to this address.

AT the inaugural meeting of the eighty-seventh session of the Institution of Civil Engineers, held on Tuesday, November 7, Sir Guilford Molesworth, K.C.I.E., the retiring president, formally introduced to the members his successor in the chair, Sir Alexander Binnie, who delivered an address to the members, in which he traced the influence of scientific thought and investigation upon the development of engineering practice. The president subsequently presented the medals and premiums awarded by the council for papers dealt with at the institution in the course of the past session.

THE fifteenth International Congress of Americanists will be held at Quebec on September 10–15, 1906. Papers in each division of the congress will take precedence in the order of the receipt of abstracts. Copies of regulations referring to papers may be obtained from Prof. F. Boas, department of anthropology, Columbia University, New York. The names of intending members or associates should be sent to Dr. N. E. Dionne, Librarian to the Legislative Assembly, Quebec.

Science reports that the Alvarenga prize for 1905 has been awarded to Dr. Chalmers Watson, of Edinburgh, for his essay entitled "The Importance of Diet; an Experimental Study from a New Standpoint." This prize is given by the College of Physicians of Philadelphia, and consists, each year, of the income of the bequest of the late Señor Alvarenga, amounting to about 36*l*. The next award will be made July 14, 1906, provided that an essay deemed by the committee of award to be worthy of the prize shall have been offered. Essays intended for competition must be received by the secretary of the college on or before May 1, 1906.

WE regret to learn that Mr. William Henry Greenwood, the eminent metallurgist, died on October 31 at fifty-nine years of age. He was educated at the Royal School of Mines, and at various periods in his career he held important positions at the works of Sir J. Whitworth and Co., the St. Petersburg Ordnance Works, and the Birmingham Small Arms Works. From 1885 to 1889 he was professor of metallurgy at Sheffield. He was the author of a well known manual of metallurgy, of a treatise on steel and iron, and of a series of metallurgical lecture diagrams, and contributed various papers to the Institution of Civil Engineers, the Iron and Steel Institute, and other technical societies of which he was a member.

THE Society of Arts will commence its 152nd session on November 15 with an opening address from the chairman of its council, Sir Owen Roberts. Among the papers set down for the Wednesday evenings before Christmas is one on the commerce and industries of Japan, by Mr. W. F. Mitchell, at which the Japanese Minister will preside. Sir William Preece will give an account of the recent meeting of the British Association in South Africa, and Mr. F. Martin-Duncan will describe recent applications of the kinematograph for scientific purposes. A course of Cantor lectures by Prof. J. A. Fleming on electric waves will also be given before Christmas. Among the courses of lectures announced for the meetings after Christmas is one under the Cantor trust on modern warships, by Sir William E. White, and one under the Howard trust, by Prof. Silvanus P. Thompson, on high-speed electric generators. The usual course of juvenile lectures will be given this year by Prof. Herbert Jackson, the subject being flame and combustion.

BARON ERLAND NORDENSKJOLD has published through Reuter's Agency some details of his eighteen months' expedition to the Andes, which was undertaken for the purpose of penetrating the northern forests of Bolivia and studying the Indian tribes along the various tributaries of the Amazon in practically unknown districts. Baron Nordenskjold left England in January, 1904, his intention being to travel *viâ* the Peruvian port of Mollendo to Puno on Lake Titicaca, at an altitude of 12,000 feet, and thence to La Paz, the Bolivian capital. He visited in all three tribes, the Yamiacas, Guarayos, and Atsapuacas, who, until a couple of years ago, lived like people of the Stone Age. The two last mentioned, in the main, still retained their original customs. No white man had ever previously visited the Atsapuacas, but yet they were in possession of tools, which they had obtained through other tribes. The expedition was unable to get into contact with a fourth tribe. The explorers marched through their territory and were constantly watched by the people, who, while abstaining from molesting the strangers, would not have any dealings with them. Baron Nordenskjöld states that the Quichuas and Aymaras, living round Lake Titicaca and in the fells of the Andes, are an interesting study for the ethnologist, as they have retained many customs unaltered, or but slightly modified, since the time of the Incas.

FROM a report in the *Times* we learn that the old students of the Royal School of Mines resident in South Africa held their annual dinner at the Rand Club, Johannesburg, on October 7. Mr. J. Harry Johns presided, supported by Mr. A. R. Sawyer and Mr. H. H. Webb. In proposing the toast of "The Royal School of Mines," the chairman emphasised the importance of teaching students to put scientific knowledge to practical use. He laid stress upon the importance of training in mechanical engineering and electricity, and congratulated the Government upon choosing a thoroughly practical engineer to fill the chair of mining at the Royal School of Mines. Mr. Brodigan, in replying, endorsed the general opinion that, considering the national importance of the mining industry to Great Britain, the Government should endow more liberally the leading mining school of the world. A letter was read from the Commissioner of Mines (Mr. H. Weldon), in which he offered a scholarship of 32*l*. to be competed for by the mining students of the Transvaal Technical Institute. Mr. Webb proposed that a register should be kept of all old School of Mines students residing in the country, and stated that the Consolidated Gold Fields of South Africa would always be ready to provide work for a certain number of students who had finished the graduation course at the Royal School of Mines. The students would earn enough at such work to maintain them while they were gaining practical experience. In connection therewith, those who have studied at the Royal School of Mines are requested, should they come to South Africa, to send their names and qualifications to Mr. C. B. Horwood, Rand Club, Johannesburg.

THE tercentenary of the birthday of Sir Thomas Browne, author of the "Religio Medici," "Urn Burial," &c., physician and philosopher, who was born in Norwich on October 19, 1605, was celebrated in Norwich on October 19 with a remarkable display of enthusiasm and interest. A statue by Mr. Henry Pegram, A.R.A., has been placed in the Haymarket at Norwich, close to the site of Sir Thomas Browne's house, and was unveiled by Lord Avebury in the presence of a distinguished company, including representatives of the Royal Colleges of Physicians and Surgeons, London, and of several of the universities and learned societies, who were afterwards entertained at luncheon by the members of the memorial executive committee.

IN the *University Review* for October (ii., No. 6) Viscount Mountmorres writes on the development of the tropics. The article is an indictment of our colonial policy on the west coast of Africa, and the energy of other nations in developing their possessions in this region is contrasted with the lethargy exhibited in our treatment of our own colonies. This applies not only in commerce but in scientific investigations, and, save for several excellent

experimental botanical gardens, there is a whole class of important questions dealing with the mineral, vegetable, and animal products of the country which is practically left to private individuals for solution.

SIR FREDERICK TREVES gave the opening address of the winter series of the Edinburgh Philosophical Institution on October 31, Lord Rosebery presiding. Sir Frederick's subject was "disease"; he said that the common conception of disease is that it is a calamity, and its end destruction, whereas disease is one of the good gifts, for its motive is always benevolent and protective. He demonstrated his proposition by a number of instances, showing that the phenomena of disease always tend to recovery and repair, though he acknowledged that in the case of malignant disease the assertion could be made that there was nothing good in it, to which no answer could at present be given.

MR. L. W. LAMBE, of the Geological Survey of Canada, has favoured us with a copy of a paper, from the *Transactions of the Royal Society of Canada*, on species of Hyracodon and the ancestral horse-like genus Mesohippus from the Oligocene of the Cypress Hills, Assiniboia.

No. 3 of the Brooklyn, N.Y., *Museum News* records improvements and additions to the central and children's museums in that city. A special feature is the collection of insects in the children's museum, this group being regarded as a peculiarly suitable one for infantile study owing to the number of its representatives and their adaptations to different modes of life.

PART v. of the first volume of the *Records of the Albany Museum* contains papers on Hymenoptera by Messrs. Cameron and O'Neil, and two on fossil reptiles and fishes by Dr. R. Broom. Several new generic types of fossil reptiles are described, but their affinities are for the most part doubtful; the one fossil fish recorded is referred to the European ganoid genus Cœlacanthus.

AN elaborate account of the alimentary tract of the mosquito is contributed by Mr. M. T. Thompson to the *Proceedings of the Boston (U.S.A.) Society of Natural History*, vol. xxxii., No. 6. The ordinary gnat (*Culex pipiens*) and two other species of the same genus afforded material for the investigation, Anopheles not being sufficiently abundant.

THE contents of *Biologisches Centralblatt* of October 15 include an article by Mr. H. Kranichfeld on the probability of the preservation and continuity of favourable variations in animals, with arithmetical calculations; a second (to be continued), by Mr. K. C. Schneider, on the elements of comparative animal physiology; and a third (likewise not completed) on "neurons," or nerve-fibrillæ, by Dr. Max Wolff, of Jena.

IN the October issue of the *American Naturalist* Prof. B. M. Davis continues his detailed account of the structure of the vegetable cell, while Prof. T. D. A. Cockerell furnishes a diagnosis of the bees of the genus Diadasia, and Dr. H. W. Shimer describes a variety of the brachiopod *Terebratalia transversa* from Alaska, remarkable for the extreme thickness and rugosity of the shell, its abraded umbo, and the presence of a small perforation on each side of the aperture for the pedicel.

THE latest issues of the *Proceedings of the U.S. Nat. Museum* include a list of American cochlidian moths, with descriptions of new genera and species, by Mr. H. G. Dyar; and descriptions of new South American moths, by Mr. W. Schaus, of Twickenham. The latter comprises no less than 479 species regarded as new, many of them indicating previously unknown generic types, one of the latter being designated Rothschildia, in honour of the owner of the Tring Museum.

THE October issue of the *Zoologist* contains a summary of the results of last season's sealing in Newfoundland waters by Mr. T. Southwell, of Norwich. It is very interesting to note that, owing to a postponement of the date for taking the young, the product of a given number of seals has exceeded that yielded by the same number last year by no less than 779 tons. That seals are still abundant is evident from the statement that one of the vessels came upon a "patch" of some 600,000, of which only a few could be killed. These northern harp-seals are stated to differ from those killed further south.

To vol. xxvi., No. 3, of *Notes from the Leyden Museum* Dr. Jentink contributes an important and well illustrated paper on the wild swine of the Malay Archipelago. In the author's opinion all these pigs are indigenous, and each island form represents a distinct species, the long-snouted *Sus oi* of Sumatra thus being distinct from the Bornean *Sus barbatus*. Dr. Jentink appears to be unaware that Mr. Lydekker, on the evidence of photographs sent by Dr. H. N. Ridley, recorded in the *Field* for last year the existence of a representative of this long-snouted group in the Malay Peninsula.

MR. J. WIMMER, of Vienna, has sent us a copy of a "booklet" of sixty-four pages by himself entitled "Mechanik der Entwicklung der tierrischen Lebewesen," published at Leipzig by Mr. J. A. Barth. In this work the author discusses, with the aid of diagrams and mathematical formulas, the mechanical adaptations of animals of all classes to the conditions of their existence, and in relation to their modes of progression. One chapter is devoted, for instance, to the mechanics of the external form of the body, a second to those of its internal structure, and a third to those of the movements of the limbs. The work appears to be a concise summary of all the essential facts connected with the subject.

NATURE-STUDY on the part of children formed an essential feature in a paper on local museums (and the discussion which followed) read at the Worcester conference of the Museums Association, as reported in the October issue of the *Museums Journal*. While it was generally agreed that the proper function of local museums is to exhibit local faunas, floras, and antiquities, some difference of opinion was expressed as to whether it is desirable to enlist the services of children in making such collections, one speaker strongly disapproving of any encouragement being given to children to collect. The discussion also took into consideration the question as to whether museum curators should be called upon to assist in teaching, but the general opinion was that if any such instruction was demanded from them it should be confined to educating the teachers.

IN part xii. of the report of the Danish Biological Station to the Board of Agriculture, Dr. C. G. J. Petersen discusses the question whether plaice undergo their whole development, from egg to adult, in the open parts of the Baltic Sea. It is well known that the pelagic eggs of the plaice are shed between November and April (most of them in the depth of the winter), and also that the fry are pelagic until such time as they become unsymmetrical, when they seek the warm shallow water of flat sunny shores, this taking place in that part of the Baltic known as the Skaw during May and June. It has been found,

however, that the number of fry which visit the shores bears no proportion to the vast quantities of spawn that are shed; and it is concluded that this loss is accounted for by the fact that the whole development can only take place in cases where the young fish, when they cease to be pelagic, are in such localities that they can be carried by the current to the warm shallow water of the shores, such fry as sink in the cold depths of the Baltic itself inevitably perishing.

In the report on the botanic station, Grenada, it is mentioned that Mr. R. D. Anstead has been appointed agricultural superintendent, and Mr. G. F. Branch agricultural inspector.

New species of flowering plants recorded by Mr. J. N. Rose in vol. xxix. of the *Proceedings of the United States National Museum* include *Dahlia Chisholmi, Parnassia mexicana*—the first species of the genus from Mexico—a Heuchera and Polianthus, all from Mexico, and an umbellifer, from the coast of Georgia, with fruits like a Carum and leaves modified into hollow-jointed phyllodes, which is made the type of a new genus, Harperia.

A comprehensive account of the distribution and ecology of the flora of west Prussia, by Mr. J. B. Scholz, appears in vol. xi., part iii., of the *Schriften der naturforschender Gesellschaft* in Danzig. The original flora is described as Baltic, and this has been enriched by the invasion of a south-east European or pontic element, consisting of plants requiring warmth and dryness, that have advanced from the steppe regions. Characteristic pontic species are *Artemisia scoparia* and *Scutellaria hastifolia* in the river valleys, and in the region of the Vistula are found *Stipa pennata, Stipa capillata, Adonis vernalis, Campanula sibirica*, and others. The writer has paid special attention to the plant associations of the moors, heaths, and forests, as they help to elucidate former migrations of plants.

The analysis of the species of Hevea is complicated partly owing to the close relationship existing between them and partly on account of the difficulty of obtaining flowers and fruit. Dr. J. Huber, of the museum at Pará, who has made a study of Brazilian rubber plants, has published a synopsis in vol. iv. of the *Boletim do Museu Goeldi*, Pará. The section Euhevea has not been augmented, but in the section Bisiphonia the variety *cuneata* has been raised to specific rank, and two new species have been formulated. Of the twenty-one species enumerated, none seems likely to rival the well known *Hevea brasiliensis*; *Hevea Benthamiana* and *Hevea discolor* are considered to be the best rubber-bearing trees growing on the Rio Negro.

The *Century Magazine* for November contains an account of the very important Egyptian finds of Mr. Theodore M. Davis, of Newport, early in the current year. Among the tombs of the kings at Thebes were found those of Ioua and Tioua, father and mother of Queen Tii, wife of Amenhotep III. and mother of the heretic King Akhenaten. In addition to the ordinary appurtenances of tombs, such as vases, the find includes stools, chairs, beds, and other furniture magnificently overlaid with gold. One of the objects found was a chariot, the pole of which was broken, as were many other things; Maspero explains this as a method of killing the object and making it available for the use of the dead, and his view would hardly be questioned by anthropologists, or, we may suppose, by Egyptologists. The writer of the article, however, Mr. Greene, appears to doubt this explanation, holding that the custom may have been practised in Peru, but that the Egyptians were on too high a level of culture for it to be thinkable that such savage ideas survived among them. This view will hardly commend itself to experts; in fact, savage survivals are conspicuous in Egypt. The article is excellently illustrated with one plate in colours and many photographs, both of the tomb and the objects found there, and of the difficult task of conveying them to a place of safety in Cairo through a land in which honesty is not one of the prevailing features.

Mr. A. A. Read gives in *Engineering* the results of a comparison of the principal methods for the determination of manganese in iron and steel. The volumetric results are slightly lower than those obtained by the gravimetric method, but they agree sufficiently closely for practical purposes. With ferromanganese the bismuthate method gives rather too low a result as compared with the ammonium acetate method, probably owing to a small quantity of the permanganate having been decomposed and filtered off with the excess of the sodium bismuthate.

The Home Office has just published the annual return of the quantity and value of various minerals raised in the United Kingdom in 1904. The total value of the mineral output was 97,477,639*l*. as compared with 101,808,404*l*. in 1903. The decrease is due to a fall in the average price of coal. The production of coal, 232,428,272 tons, was the highest hitherto recorded. The output of gold from Merionethshire rose from 5495 ounces in 1903 to 19,655 ounces in 1904, the value of the gold being 73,925*l*.

We have received from the author, Dr. H. Potonié, professor at the Berlin School of Mines, a copy of the third edition of his interesting work on the origin of coal (Berlin: Borntraeger Brothers, 1905, price 4*s*.). It is an admirably illustrated pamphlet of 53 pages prepared to elucidate the diorama of a Coal-measure landscape exhibited by the Erkelenz Boring Company at the Liége International Exhibition. It is written in French and German in parallel columns, the French translation having been made by Prof. Gaspar Schmitz, of Louvain. Prof. Potonié's views as to the origin of coal are well known from his previous publications. He now brings forward further evidence to show that, just as at the present time the deposits of humus were almost exclusively formed *in situ*, in previous geological times it was also the rule that such beds were formed at the place where the plants grew from which they were derived.

Dr. van Rijckevorsel has sent us a copy of an elaborate and valuable discussion entitled "Constantly Occurring Secondary Maxima and Minima in the Yearly Range of Meteorological Phenomena." Dr. van Rijckevorsel, who is an honorary assistant attached to the Meteorological Institute of the Netherlands, and has for many years been known as a conscientious and painstaking investigator in the domain of meteorology and terrestrial magnetism, has divided the present work into two parts. The first portion exhibits ordinary mean daily values and smoothed means for many stations, mostly in the northern hemisphere, for a large number of years, and for various elements, with curves of the normal annual range of temperature. The principal results of the investigation show (1) that the resultant curve of daily normal temperature in the northern hemisphere is a continuous zigzag of maxima and minima; the rise from the winter minimum to the summer maximum is not uniform, but occurs in

spells or periods which at times are so strongly pronounced that the mean temperature falls, instead of rising, for several days together, and these irregularities, generally speaking, occur everywhere at the same time. (2) That this phenomenon is apparently similarly exhibited over the whole globe. (3) That probably other elements than temperature, even those not generally reckoned as meteorological, exhibit the same peculiarity. (4) That it is not improbable that these occurrences are connected with the sun's activity. In the second portion of the work the author endeavours to show that there is great probability that the same phenomenon really occurs in the southern hemisphere, but the data available do not at present allow of positive conclusions. The magnitude of the work undertaken may be gauged from the fact that the observations of some 3636 years have been discussed. In this portion of the discussion Dr. van Rijckevorsel has departed from the usual method of treating the means of observations from any particular locality as a separate unit, but has thrown all the observations for any year together, irrespective of place or date, as he considers that this method gives better data for the object in view.

THE *Proceedings of the Mathematical Society of Edinburgh* for the session 1904–5 open with a systematic paper on the properties of the envelope of the Wallace or Simson line by M. Collignon, including not only geometrical, but also kinematical considerations. Dr. Mackay also publishes a bibliographical note intended to accompany Collignon's memoir. Mr. R. F. Muirhead gives new proofs of Newton's theorem on sums of powers of roots, and also of Waring's expression for the sum of the powers in terms of the coefficients. Mr. E. B. Ross contributes a neat discussion of the degree of contact between a curve and its envelope; and in a paper on polar loci Mr. D. G. Taylor, in order to get rid of the confusion due to multiple values of r for what seems to be graphically one value of θ, imagines an infinite number of parallel planes one above the other slit up from 0 to ∞ along the initial line and joined together so as to form a kind of helical surface. Dr. Muir communicates a note on the condensation of continuants, and Prof. Bromwich gives a useful method for distinguishing the ambiguous cases in the solution of spherical triangles.

IN the *Transactions of the Faraday Society* (vol. i., part iii.) Mr. Sherard Cowper-Coles gives an interesting account of the various processes which have been suggested for increasing the rate of deposition of electrolytic copper on a commercial scale. It is claimed that the centrifugal process is at least ten times as rapid as any other process. When the mandrel which constitutes the kathode is rotated with sufficient rapidity, smooth, thick deposits of copper in the form of tubes are obtained which show no trace of lamination. The paper is illustrated by numerous plates, in which the influence of the rate of rotation on the character of the electrolytic copper is clearly evident.

THE supposition that radium is a disintegration product of uranium has received considerable support from the investigations of Strutt, McCoy, and Boltwood. The question whether the production of radium from a pure uranium compound can be experimentally detected would, however, seem to be answered in the negative by recent experiments of Mr. Bertram B. Boltwood, published in the *American Journal of Science*, vol. xx., 1905. Observations on a solution containing 50 grams of uranium, which extended over a period of 390 days, indicate that the quantity of radium formed is less than $1{\cdot}7\times10^{-11}$ gram. This is less than one sixteen-hundredth of the quantity which would be expected from the disintegration theory, and the author concludes that one or more products of a slow rate of change intervene between uranium and radium.

THE *Revue générale des Sciences* for September 15 contains a reprint of a lecture which was delivered by Prof. P. A. Guye before the Chemical Society of Paris on new researches on the atomic weight of nitrogen. The author reviews the results already obtained, and concludes that sufficient differences exist to render fresh determinations necessary. The classic gravimetric methods are not considered sufficiently accurate, and a description is given of new methods of determining the atomic weight of the element based on the analysis of nitrous oxide. A spiral of iron wire is heated electrically in a known weight of the gas and the increase in weight found. In another series of experiments, an iron spiral is similarly heated in a known volume of nitrous oxide. The mean value assigned for the atomic weight is 14·009. An article is also contributed to the same number by MM. J. de Kowalski and J. Dalemont on the teaching of applied science at Fribourg University.

AN important paper by Mr. H. v. Steinwehr on the influence of the size of crystals of mercurous sulphate on its relations to electromotive force ("Vorlaüfige Mitteilung über den Einfluss der Korngrösse auf das electromotorische Verhalten des Merkurosulfats") has lately been published in the *Zeitschrift fur Instrumentenkunde*, 1905, Heft. vii. The paper deals with a subject of great interest, and one which at the present time is occupying a great deal of attention in all countries in connection with the preparation of standard cells. The author experimented on samples of mercurous sulphate obtained from different makers, and found that they gave a difference of electromotive force equal to 5×10^{-4} volts; it was also found that they varied in solubility. On examining them under a microscope a difference in the size of crystals was observed, the smaller crystals having a higher solubility and higher E.M.F. The subject was pursued both in the direction of reducing the crystals by grinding and of increasing them by crystallisation, and the same result was obtained, viz. the larger the crystals the lower the solubility and the smaller the E.M.F. The author thinks it highly probable that the size of crystals is the chief, if not the only, cause of the differences observed in different samples of mercurous sulphate. He further criticises the conclusions of Hulett that it is the presence of basic salt that affects the result. In conclusion, he discusses the electrolytic method of preparation suggested by Hulett and Fr. A. Wolff and recommended by Carhart for standard cells, stating that it is bound to lead to the production of crystals of very varying size, and the device used by them of continuing the stirring after the circuit is broken cannot have the desired effect, as the crystallisation of mercurous sulphate is very slow. We await with interest the further communication by the author, and hope he will then have some suggestion as to an improved method of preparation.

WE have received part i. of a book on leather dressing, including dyeing, staining, and finishing, by Mr. M. C. Lamb, director of the leather dyeing department, Herold's Institute, Bermondsey. This portion, containing thirty pages, is the first of twelve monthly parts of which the book will consist; it deals with sorting, splitting and shaving, and is well printed and illustrated, the working parts of the machines described being explained by

diagrams. Until the book is completed it would be impossible to form an opinion of its value, but the first part promises well.

THE annual report of the board of regents of the Smithsonian Institution for the year ending June 30, 1904, has now been published. As usual, the general appendix to the report, which makes up about seven-eighths of the volume of 804 pages, will prove most interesting to British readers. This appendix contains more than fifty articles upon scientific subjects to which special attention was directed during the year with which the report deals. Five of the articles represent addresses at the congress of arts and sciences held at St. Louis during September, 1904. Among these may be noticed that of Prof. H. H. Turner, F.R.S., on some reflections suggested by the application of photography to astronomical research; Mr. C. T. R. Wilson, F.R.S., on condensation nuclei; and Sir William Ramsay, K.C.B., F.R.S., on the present problems of inorganic chemistry. Two addresses delivered at the Cambridge meeting of the British Association are also reprinted. A generous selection of articles from important American, French, German, and British scientific publications is included, and nearly every department of scientific knowledge is represented. There are several articles which appear to have been contributed specially to this report, and of these may be mentioned the essays of Dr. S. P. Langley on experiments with the Langley aerodrome (see p. 645), Dr. J. O. Skinner on the house sparrow, Dr. Theodore Gill on flying fish and their habits, Mr. Edgar L. Hewett on a general view of the archæology of the Pueblo region, Dr. Ales Hrdlička on the painting of human bones among the American aborigines, and Mr. W. C. Gorgas on the sanitation of the Isthmian Canal zone. The profusion and excellence of the plates and other illustrations again call for remark. Readers who are fortunate enough to have access to these yearly reports are provided with an excellent means of keeping abreast of current scientific studies.

OUR ASTRONOMICAL COLUMN.

ITALIAN OBSERVATIONS OF THE RECENT SOLAR ECLIPSE.—A series of valuable observations of the partial eclipse of the sun was made at Aosta (Italy) on August 30, and the results are given in No. 17 (1905) of the *Comptes rendus*.

The times of contacts, the meteorological changes, and the spectroscopic phenomena were observed in an atmosphere of exceptional purity, and, in connection with the last named, Dom Cl. Rnzet describes what he believes to be a unique observation. At about 1h. 40m. (Paris M.T.) the cusp of the crescent sun (position angle about 90°) was projected on to the widened slit of the spectroscope, arranged perpendicular to the solar limb, and the lines C and D_3 were seen very bright and showing a hazy, cloud-like prominence.

The bright line in each case, however, was divided sharply into three parts. First, on the red side was a broad bright line with sharp edges, then came a narrow, well defined *dark* line, and finally, on the more refrangible edge, a bright line showing the form of the prominence was seen.

MARTIAN METEOROLOGY. In No. 8, vol. liii., of the *Harvard College Observatory Annals*, Prof. W. H. Pickering discusses a number of photographs of Mars some of which were taken with the 13-inch Boyden telescope at Cambridge (Mass.) in 1888, and the others at Mt. Wilson, with the same instrument, in 1890. Although these photographs do not show the canals and lakes, they show sufficient variation, due to meteorological changes, for a discussion of Martian meteorology.

Prof. Pickering describes, in order, the appearance and disappearance of clouds, snow, &c., and deduces therefrom some valuable suggestions as to the seasonal changes which take place on or above the planet's surface, giving, in each case, the equivalent terrestrial date at which these changes occur. Nine reproductions from the original photographs, on a scale of 1 mm. = 200 km., accompany the paper, and show the clouds, &c., to which Prof. Pickering refers; the Sinus Sabæus and the Syrtis Major are also shown on some of them. On two occasions the height of the clouds above the Martian surface was measured, giving about 15 miles as the result, and Prof. Pickering suggests that the existence or non-existence of such clouds in the equatorial regions may account for the discrepancies noted between various estimations of the amount of the polar flattening.

In conclusion, Prof. Pickering points out that there is now direct evidence of an effective atmospheric circulation of moisture on Mars which would seem to account, adequately, for the observed transfer of precipitation, during the Martian year, alternately from pole to pole.

A 300-YEAR CYCLE IN SOLAR PHENOMENA.—From a lengthy discussion which appears in No. 1, vol. xxii., of the *Astrophysical Journal*, Mr. H. W. Clough, of the Washington Weather Bureau, arrives at the conclusion that a 300-year cycle exists in solar, and the allied terrestrial, phenomena. In the first place, Mr. Clough discusses the observations of numerous terrestrial phenomena which are supposed to be dependently associated with solar changes, and finds that a 36-year cycle is common to these and to solar variations. He then shows that the 36-year cycle varies in length during a cycle of 300 years, and supports this by reference to old observations of various terrestrial phenomena, *e.g.* auroræ, time of grape harvest, &c., extending back to the early centuries of the Christian era.

SOME SUGGESTIONS ON THE NEBULAR HYPOTHESIS.—In a paper communicated to the Royal Society of Edinburgh, and published in part vii., vol. xxv., of the *Proceedings* of the society, Dr. Halm makes some suggestions, concerning the probable genesis of the solar system, which may overcome some of the difficulties experienced in the acceptance of Laplace's theory. Whilst the Laplacean hypothesis considers that the matter now forming the planets was thrown off by the original *rotating* nebulous mass, a consideration which is not consistent with the principle of the constancy of the rotary momentum in a system, Dr. Halm suggests that the conditions necessary for the formation of planets were not introduced until after the solar body had condensed from a *non*-rotating nebula into a spherical body having a diameter probably less than the distance of Mercury. This spherical body then encountered a swarm of meteorites, and finally a ring of these bodies, rotating with orbital velocities about the solar nucleus, was formed.

The planets were formed subsequently by the evacuation of the ring by the larger nuclei existing therein, their rotary motions being generated by the tangential impulses given to each nucleus by the smaller masses falling into it. Many subsidiary considerations are discussed in Dr. Halm's paper, but they are too lengthy to be given here.

SYSTEMATIC ERROR IN TRANSIT OBSERVATIONS OF JOVIAN SPOTS.—We recently referred in these columns (September 21) to a suggestion made by the Rev. T. E. R. Phillips to account for a systematic error in eye-estimates of the transits of Jupiter's spots, and, in the current number of the *Observatory*, Mr. Stanley Williams supplements Mr. Phillips's remarks with a brief discussion of his own results, in which a similar, but larger, systematic error seems to exist. Mr. Williams suggests that the phase-darkening of any long feature such as the red spot, or hollow, may introduce the error. For example, at the quadrature preceding opposition the planet's disc for some distance from the preceding limb is less bright than it is near to the following limb, but at the quadrature following opposition the reverse is the case. As the spot and the hollow are so long, the transit is observed, in practice, by comparing the relative spaces between their ends and the limb, and if the latter are unequally bright, irradiation may lead to such a systematic error as the one which appears in the results.

THE ORBIT OF σ CORONÆ BOREALIS.—As the orbits calculated from the observations of σ Coronæ Borealis show great divergence, ranging from 200 to 800 years, Prof. Doberck has investigated this subject, and now publishes the results in No. 4051 of the *Astronomische Nachrichten.* The set of elements which he gives depends upon Herschel's measures of the angle, and shows the period to be about 1679 years, and the motion to be direct.

Prof. Doberck states that the hypothetical parallax of this system is 0″·064, but the actual parallax is probably smaller, and that the mass of the system is probably greater than that of the sun.

RADIAL VELOCITIES OF CERTAIN VARIABLE STARS.—The results obtained by Prof. Frost from a series of spectrographic observations of certain variable stars (chiefly of the Algol type) are given in No. 3, vol. xxii., of the *Astrophysical Journal.*

R Canis Majoris, Z Herculis, and U Sagittæ are shown with certainty to be spectroscopic binaries, their determined velocities corresponding, in sense, to what would be expected from the phase in the light variation at the time of observation.

VARIABILITY OF THE ASTEROID (444) GYPTIS.—The variability of the apparent brightness of the minor planet (444) Gyptis is suggested by the results obtained from a series of observations made at Heidelberg and published by Dr. W. Valentiner in No. 4050 of the *Astronomische Nachrichten.*

In the same journal it is suggested, by Dr. Palisa, that the magnitude of minor planet 1905 RB is also variable.

CONFERENCE OF DELEGATES OF LOCAL SCIENTIFIC SOCIETIES.

AS it was not deemed expedient to call a meeting of the delegates of the corresponding societies of the British Association during the session in South Africa, it was arranged that a special conference should be convened subsequently in London. This meeting was held at the rooms of the Linnean Society on Monday and Tuesday (October 30 and 31), and was largely attended by representatives of various scientific societies in England, Scotland, and Ireland.

Dr. A. Smith Woodward, who presided at the conference, delivered an inaugural address rich in sympathy with the efforts of the provincial societies to further the progress of science, yet not without a word of gentle reproof to such societies as give undue prominence to the picnic element, which rather tends to the estrangement of the working naturalist. Probably the best work of the smaller societies was, in the chairman's opinion, that of instruction in the current progress of science. He suggested that it would be salutary to dwell on the unsolved problems of science, and pointed out the need of books which should treat of our ignorance rather than our knowledge, and so indicate the direction in which investigation is still urgently needed. Dr. Woodward condemned as extremely unfair the growing practice of certain societies to solicit men of scientific renown to deliver popular lectures without fee. Warm approval was expressed of the recent action of the British Association in seeking to extend its usefulness by including within its union the smaller non-publishing societies and field clubs, which will form henceforth a new class of *associated* societies distinct from the group of *affiliated* societies which publish original investigations in science.

Dr. W. Martin, of the Temple, introduced a discussion on the law of treasure trove, with the view of inducing the various local societies to assist in the preservation of antiquities found within their sphere of influence. While generally defending the law he advocated some revision, especially in the mode of its administration. He suggested that notices should be widely circulated, say at the post-offices throughout the country, explaining to the public that the finder of valuable relics would receive reasonable remuneration. In a similar way, relics like stone implements might be secured, where desirable, by the State.

Mr. Morris Colles, the director of the Authors' Syndicate, and Mr. Harold Hardy explained the present law of copyright as it affects the published proceedings of scientific societies. The general sentiment of the meeting seemed, however, to be in favour, not of hindering in any way the re-publication of papers, but rather of encouraging the dissemination of knowledge by favouring publication, naturally with due acknowledgment of the original source of information.

Prof. G. S. Boulger read an interesting paper on the preservation of our native plants, which led to a valuable discussion. There seems no doubt that some of the rarer indigenous plants are in serious danger of extermination, not wholly through thoughtlessness on the part of the public, but partly through the cupidity of botanists—an evil which has increased since the extension of nature-study. It was proposed that legislation should ultimately be sought for the protection of certain plants, but that meanwhile a circular should be issued bringing the subject before teachers, members of field clubs, and others interested in our flora and likely to assist in its conservation.

In addition to attending the two meetings, the delegates visited the Museum of the Royal College of Surgeons under Prof. Stewart, and, on the evening of October 30, dined at the Royal Societies Club, where they were received as guests.

ZOOLOGY AT THE BRITISH ASSOCIATION.

THE work of Section D was formally opened on Wednesday, August 16, with the president's address on "The Distribution of African Fresh-water Fishes," which has already been printed in NATURE (August 24, p. 413). This was followed by a paper by Mr. L. Doncaster entitled "Recent Work on Gametogenesis and its bearing on Theories of Heredity," which took the form of a *résumé* of the most important recent work on the relation between the phenomena of nuclear division and those of heredity. It was shown that whilst ample confirmation had been obtained of Weismann's hypothesis that the chromosomes are the bearers of inherited characters, yet the most recent work on the maturation of the germ cells had demonstrated the fact that they contained a mechanism which seemed precisely adapted to bring about that segregation of characters which forms the most fundamental part of the Mendelian theory; it was difficult, therefore, to believe that the two things were unconnected. The remainder of the paper was devoted to the consideration of certain obvious difficulties standing in the way of a complete correlation.

The programme for Thursday, August 17, was opened by Dr. J. D. F. Gilchrist with a paper on cases of extensive mortality among marine animals on the South African coast, with suggestions as to their cause or causes. After narrating specific cases of enormous quantities of fish either dead, or alive but "in a stiffened condition," being thrown up on various points of the coast, the author suggested that these occurrences might be due to a peculiar feature of the Cape seas, viz. the great difference in temperature, salinity, and contents of the warm Agulhas Stream of the Antarctic drift current, and expressed the hope that his notes might be of some use in directing attention to this problem and securing additional evidence in connection therewith. The paper was followed by a demonstration of the more interesting forms in a collection of deep-sea animals shown in the museum of the South African College, special attention being devoted to certain questions, such as methods of reproduction of deep-sea fish, the significance of luminous organs, and parasitism. A short paper by Mr. A. H. Evans on the ostrich and its allies was intended to be introductory to a contribution on ostrich-farming by the Hon. Arthur Douglass, one of the pioneers of the industry in the colony. In the latter paper the writer supplied a large amount of interesting information relating to the first commencement of ostrich farming in 1867 and its growth up to the present time, the best climatic and general conditions for the industry, the results of artificial hatching as used in the early days of the industry as compared with present methods of rearing the chicks, the principal diseases of the birds, the present different methods of farming them, the growth of the export of feathers and the range of values, the improvement of the breeds by selection to obtain better feathers,

the prospects of future development of the industry in South Africa, and of its being successfully developed in other countries. The reports of the committees on grants, which were also taken on this day, did not offer any special points of general interest.

The greater part of the sitting on August 18 was devoted to a paper on the origin of mammals, by Prof. Broom, in which the author had occasion to make extended reference to his work on the Triassic reptiles of South Africa in support of his views of a reptilian origin for the mammalian group. The author gave reasons for believing that in early Permian times a cotylosaurian reptile, owing to its frequenting marshy ground, took to walking with its body well supported off the ground. This habit gave rise to the forward direction of the ilium, and to the pubis and ischium being turned backwards, as also to the great development of the precoracoid. No member of this first stage in the mammalian line was at present known, but Pareiasaurus was apparently a considerably modified offshoot from it.

The next stage in the development arose by the marsh animals finding that the new modification of the limbs was specially suitable for progression on land. The new type of land animal was better equipped than the normal reptile, and took to predatory habits and became an active carnivorous animal. These early carnivorous types form the order of Therocephalians, of which about twenty genera are known. Between the Upper Permian and the Upper Triassic times the Therocephalians gave rise to the much improved Theriodonts or Cynodonts. These Theriodonts are almost mammals in every detail of structure, the only essential difference being that the lower jaw has still a small articular element, which hinges on a small quadrate bone. The change from the Theriodont to the mammal was probably brought about by a slight change of habit necessitating some antero-posterior movement of the jaw, the small quadrate bone becoming first a plate of bone and then a plate of cartilage—the inter-articular cartilage, the dentary taking the place of the articular. Neither the auditory ossicles nor the tympanic have ever had anything to do with the articulation. The mammalian malleus was held to be the reptilian extra-stapedial and the mammalian incus the supra-stapedial. The connection between Meckel's cartilage and the malleus, which is hyomandibular, was held to be similar to that between the extra-stapedial and the mandibular cartilage in the crocodile. The mammalian tympanic was considered to be the homologue of the distinct tympanic bone of Anomodonts and Theriodonts. The paper gave rise to considerable discussion, in which Prof. W. B. Scott of Princeton, the president, and others took part, and was followed by a communication from Dr. W. F. Purcell on some early stages in the development of Peripatus, in which the writer maintained that an examination of the segmentation stages of the ovum of *Peripatus balfouri* preserved in formalin shows that the endodermal cells are oval or spherical bodies with well defined convex or flattened contours, but without any anastomosing branches connecting the cells with one another or with the ectoderm. The embryo in the segmentation stages is therefore not a syncytium, as maintained by Mr. A. Sedgwick. The remainder of the session was devoted to an important paper on the habits and peculiarities of South African ticks, by Mr. C. P. Lounsbury, which the sectional committee resolved to print *in extenso* in the *Proceedings* of the association, whilst certain details in the structure of the buccal apparatus of a tick (*Haemaphysalis punctata*) were elucidated in a concluding joint paper by Drs. Nuttall, Smedley, and Cooper.

The first day of the proceedings at Johannesburg (Tuesday, August 29) was opened by Prof. Herdman, F.R.S., who gave an account, illustrated with lantern views, of his well known investigations on the pearl-oyster beds of Ceylon. This was followed by an interesting communication on Cephalodiscus by Dr. S. F. Harmer, F.R.S., in which the author gave a preliminary account of the new species discovered in African seas by Dr. Gilchrist. The session was concluded with a demonstration of ankylostoma preparations by Mr. A. E. Shipley, F.R.S.

The programme for Wednesday, August 30, was opened by Prof. E. B. Poulton, F.R.S., who gave a lecture, illustrated with lantern slides, on mimicry in South African insects. This was followed by a paper by Mr. W. L. Sclater, director of the South African Museum, on the migration of birds in the southern hemisphere. For the purposes of the paper the author took the list of birds contained in the recently published volumes of the "Fauna of South Africa," written by the late Dr. Stark and himself, together with those of the fourth volume, shortly to be issued. The number of species described in the four volumes was 814, which the author divided into five categories, as follows:—residents, 631; northern migrants, 76; African migrants, 21; partial migrants, 50; and island breeders, 36. Mr. Sclater stated that he considered it would be most unwise to evolve any theories on migration in South Africa at present, owing to the dearth of observations hitherto recorded. He was, however, in hopes of making some advance by the distribution of schedules among the lighthouse keepers along the coast, teachers in the schools all over the country, and any others who would undertake to make the observations, for the purpose of recording, day by day and month by month, the appearance of different species of birds.

Mr. C. B. Simpson, the Transvaal Government entomologist, then read a paper on locust destruction in the Transvaal during the season 1904–5, in the course of which the writer gave an outline of the history of the locust pest in other countries, and then proceeded to describe the locust invasions in South Africa, due to two species, *Acridium purpuriferum* (the purple locust) and *Pachytylus sulcicollis* (the brown locust). Although both species were shown to have many natural enemies, yet every natural method of decimation was found to be insufficient. Therefore, in order to save the farmers' crops, recourse had to be had to artificial means. Amongst the methods adopted were beating by hand, tramping with stock, crushing with rollers, burning grass, driving into trenches, the use of locust screens, and spraying. The screens were described in detail with the help of the lantern, the author stating that twenty miles of them were distributed throughout the Transvaal for the use of farmers. Spraying was, however, the most efficient means for the destruction of locusts. The spray used was arsenate of soda, and it was given to the farmers free, while the screens and spray-pumps were lent without charge. The results of the campaign in the previous year had been most gratifying. It was of course stated that the Transvaal, still less South Africa, could not expect to eradicate the pest completely on account of the vast area of unoccupied country; but the author's department did hope to place in the hands of the farmers a means whereby by combined action they could kill the insects and protect their crops. If they could do this they would consider that success had been achieved. With the purple locust the author believed they had proved that the farmers could do this, but with the brown locust they had not yet had sufficient experience to be able to tell whether they could prevent injury or not. The concluding paper of the session, by Dr. H. Lyster Jameson, was entitled "On Some South African Land Planarians," and dealt with certain points in their anatomy.

The concluding meeting of the section was held on Friday, September 1, on which day Prof. W. B. Scott, in an opening paper on convergent evolution as illustrated by the Litopterna, maintained that while convergent evolution was admitted by most naturalists to be a frequent and important phenomenon, there was a great difference of opinion as to how nearly identical the results of such a mode of development might be. So far as the Litopterna were concerned, there were striking resemblances to certain Perissodactyls in teeth, skull, and skeleton, but the differences were many and fundamental. It did not appear at all likely that so complex a structure as a mammalian skeleton was ever produced in identical terms by two independent series.

In the course of the succeeding paper, on a neurosyncytial theory of development, Dr. W. H. Gaskell, F.R.S., referred to his theory of the origin of vertebrates, and pointed out that it was based upon the paramount importance of the central nervous system as the chief factor in the upward progress of the animal kingdom. Every line of investigation pointed to the conclusion that the

vertebrate arose from that group of invertebrates which possessed a central nervous system most nearly similar to that of a low vertebrate such as Ammocœtes, an invertebrate, therefore, belonging to the group of arthropods. This argument had been worked out by the author in a series of papers published in the *Journal of Anatomy and Physiology*, and receives especial support from the palæontological record. For the dominant race now, the biped mammal man, arose undoubtedly from the highest race evolved up to that time—the quadrupedal mammals; these in their turn originated from the dominant reptiles; these again from the amphibians, which were the most highly organised group of their day. The amphibians themselves came from the dominant race living in the sea at the time—the fishes; so, too, according to the author's theory, the fishes arose directly out of the race previously dominant, *i.e.* the arthropod group. This theory necessitates the formation of a new alimentary canal at the transition from the arthropod to the vertebrate—a requirement which is no more unlikely than the formation of a new respiratory apparatus at the transition of a fish into an amphibian. The reason why others have found this formation of a new alimentary canal so difficult of acceptance is because embryology—and embryology alone—in its recent teaching makes the alimentary canal, and not the central nervous system, the important organ around which the animal is built up. The author, basing himself especially on Braem's papers in the *Biologisches Centralblatt*, pointed out that in reality the germinal layer theory was a physiological and not a morphological conception, that the one criterion of hypoblast was not its mode of formation but its ultimate fate; whether or no, the definite alimentary canal was formed from it. Morphological laws of development must exist, but to quote Samassa, "one thing can be said with certainty at the present time, the germinal layer theory is not one of them." The author suggested a re-consideration of the whole matter, and, starting with the adult, pointed out that the tissues of the body fall naturally into two great groups, those which are connected with the central nervous system, the master tissues of the body, and those which live a free existence without any such connection. The body might be looked upon as composed of a neuro-epithelial syncytium, in the meshes of which free cells live.

Prof. Cleland, F.R.S., in conclusion, read a communication on the growing-point of the Vertebrata, in the course of which he pointed out that while the medullary folds appear in close connection with the blastopore, and the parts concerned with the cranium and its contents are the first to appear, both mesoblastic somites and spinal nerves appear in succession, each metamere behind that which is immediately proserial to it. It follows, therefore, that it is from the short space between the medullary folds and blastopore that new metameres of the neuro-muscular system are formed, and there is no reason to doubt, the author held, that the visceral system is extended in the same manner. The nucleated corpuscles of this region furnished, therefore, in his opinion, the parents of the corpuscles of which the successive metameres of the trunk are composed, and they do so by giving off successive series of corpuscles which belong each to a particular metamere.

EDUCATIONAL SCIENCE AT THE BRITISH ASSOCIATION.

THE most noteworthy feature in the educational science section at the South African meeting of the British Association was the address of its president, Sir Richard Jebb, an address which was originally delivered at Cape Town, and repeated with a little variation at Johannesburg. The address, which was printed in full in NATURE of September 28 (p. 545), dealt with the idea of a university and the distinction which marks off the teaching of a university from that of a higher technical school or similar institution.

The subject of the address was the more apposite in that the most pressing educational question in South Africa at the present time is the creation of a teaching university. The present Cape University is an examining body only, and it has been suggested that the time has come for it to grow into a teaching university by the combination of the colleges at present preparing for its examinations, much as the University of London was so recently re-created. The difficulties, however, both of funds and of conflicting interests have not yet been overcome.

At Johannesburg, also, the successful start of the recently established technical institute has led to a plan for its growth into a university, with engineering, agriculture, law and education as its main faculties, and it seems not unlikely that liberal financial support would be forthcoming should it be decided on fuller consideration to adopt such a scheme.

At the sectional meetings a large proportion of the papers was contributed by teachers resident in South Africa, so that opportunities were afforded to the visitors of learning what were the more pressing educational problems, and to the local members of discussing these problems on a wider platform. At Cape Town the Rev. W. E. C. Clarke gave a general review of the development of education in the colony, laying particular stress on the perennial difficulty of providing any efficient scheme for the instruction of the widely scattered country population. Mr. Clarke's paper excited considerable interest, and led to renewed discussion, especially the latter portion, which dealt with the status of the teacher in Cape Colony. He spoke of the power of the Cape Teachers' Union, and deplored the tendency of their conferences to be rather exclusively occupied with questions of salary and allowances instead of leading public opinion on matters of educational policy.

Mr. W. W. Way, principal of the Graaf Reinet College, also contributed a brilliantly written and hard-hitting paper on the disabilities of the South African schoolboy. He pointed out how the semi-tropical climate, the wealth of sun and air, the freedom and isolation of the life of the South African boy, while they produce an alert and self-reliant race, do not work well in the interests of education. The youth are essentially undisciplined and unintellectual, while the early physical development brings its own dangers. Mr. Way touched upon the further difficulties, both as to mind and morals, which arise out of the proximity of the native, the co-existence of two languages, the inferior type of teacher that characterised the past, and the narrowing influence of many of the religious bodies in the country. Nothing but an ampler endowment and a general rise in the status of the teacher can induce in the future South African a proper respect for his intellectual development.

The general history and administration of education in the other colonies were thoroughly dealt with at the Johannesburg meeting in a series of papers contributed by Mr. Warre Cornish, Mr. Gunn, and Mr. Duthie. They all showed certain common problems the scarcity of suitable teachers and the necessity of improving their status and training, the expense of providing adequate school buildings, and the difficulties induced by the isolation of the farms. This latter question of education upon the Veld was also dealt with in a breezy paper by Mr. J. H. Corbett, a vivid and sympathetic presentation of the case, in which the author evidently trusted more to the self-devotion of the individual teacher than to any possibilities of organisation.

The second meeting at Cape Town opened with a paper by Mr. W. M. Heller on the methods of teaching science, with an introduction by Prof. H. E. Armstrong. At its close Mr. Oscar Browning expressed his dissent from the current view of the "heuristic" method as an instrument of education it was valueless, and all good teachers of history and literature had worked by this method long before Prof. Armstrong resuscitated its unhappy name. Mr. A. D. Hall claimed that the value of the "heuristic" method lay in the inspiring ideal it set up; unrealisable as it might be, the natural tendency of the teacher was to drift along the other easier way of giving instruction *ex cathedra* instead of by the path of discovery and experiment. Mr. G. Fletcher, however, rather hit off the feeling of the meeting when he suggested that a close time should be declared for discussions of the "heuristic" method, which had in past years occupied far too much of the

attention of the educational section. Mr. Fletcher's own paper, which followed, dealt with the development of technical education in a new country, and suggested that many of the methods which had been successful in Ireland in the way of creating public interest and of eliciting the cooperation of the locality might well be adopted in South Africa. Nor should the Administration be deterred from making a start with technical education at any centre by reports as to the apathy of the residents; Irish experience would seem to show that a supply of good instruction would always produce an increasing demand for it.

The very important question of agricultural education was treated at Johannesburg by Mr. F. B. Smith, the Director of Agriculture in the Transvaal, and by Mr. A. D. Hall at Cape Town. Mr. Smith showed how efficiently an intelligence department had already been organised in the matter of agriculture in the Transvaal, where the farmer had at his call a service for investigation and advice which could not be rivalled in any other British country. An enormous amount of work had now been done on such matters as the introduction of improved crops, the eradication of stock diseases, &c., and the Afrikander farmer was beginning to rely upon the help of the department. Mr. Smith further outlined the nature of the course it was proposed eventually to establish in the Transvaal in connection with the future university. Mr. Hall was disposed to think that questions of economy would necessitate the colonies concentrating their efforts chiefly upon their expert staff for investigation and work among the current generation of farmers, and that there was not the same call for another staff to give instruction in the higher branches of agricultural science. The type of instruction for which the most pressing demand existed was a practical training in more improved methods of farming, and this could well be developed in connection with the experimental farms that had already been instituted in various parts of the country. It seemed as yet hardly worth while to create an elaborate teaching institution to produce the small number of experts and Government officers whom the country would require yearly, since suitable men could be picked out during the earlier practical courses of instruction and sent home to complete their scientific training.

One question, which recurred constantly during the tour, both in section meetings and in conversation, was that of native education, a thorny subject interwoven with many prejudices, both racial and religious. The general feeling among colonials is almost wholly opposed to education of what may not unfairly be called the ordinary missionary type, which seeks to teach the native to read and write English. Many large employers of labour refuse to engage any native acquainted with English, and other experienced men declare that the only effect of such a bookish training as has been given in the past is to make the native parasitic, either upon the white community or his more primitive fellows. But education by means of handicrafts, and proceeding entirely in the natives' own language, meets with general approval, both as supplying a much desiderated discipline and making the native more efficient economically, and also as likely to prove a sound method of eventually leading the native on to a higher plane of civilisation. This is essentially a matter on which the visitor can only speak with diffidence; indeed, it is claimed that many of the difficulties have arisen from the ill-considered, though well meaning, action of people at home.

The papers of more general interest included a discourse by Dr. J. H. Murray on "the world of words," in which he discussed, with appropriate illustrations from the English language, the various types of words and the manner in which they originated. Dr. Brill, rector of the Grey College at Bloemfontein, again submitted a paper of great interest on the origin of the "Tael," the form of Dutch commonly spoken throughout South Africa. The Tael he holds to be a pure Dutch, "clipped," however, by the removal of practically all inflexions, genders, and irregular forms. What little foreign element exists in the language he attributes to early intercourse with the East, and regards it in the main as of Malayo-Portuguese origin. The members of the British Association who were interested in education had many opportunities of seeing the schools in the centres they visited, and also of intercourse with the teachers at work in them. The raw material with which the latter have to deal may not as yet have imbibed any great keenness for learning, but the general attitude of the citizens of the country towards education, as indicated, for example, in such matters as school buildings (often in the smaller towns of Cape Colony the most notable public building was the school), shows a life and determination which will not be long before bearing fruit.

THE SCOTTISH NATIONAL ANTARCTIC EXPEDITION.

A SUMMARY of some of the preliminary scientific results of the Scottish National Antarctic Expedition appeared in the August number of the *Scottish Geographical Magazine*, and this has now been issued in the form of a corrected reprint, from the office of the expedition in Edinburgh. The pamphlet contains an introduction by Mr. W. S. Bruce, the leader of the expedition, a paper on the bathymetrical survey of the South Atlantic Ocean and Weddell Sea, also by Mr. Bruce, and short papers on the deep-sea deposits, by Dr. Harvey Pirie, on the meteorology of the expedition, by Mr. Mossman, and on Diego Alvarez, or Gough Island, by Mr. Rudmose Brown. An account of part of the work of the expedition has already appeared in these columns (NATURE, March 2).

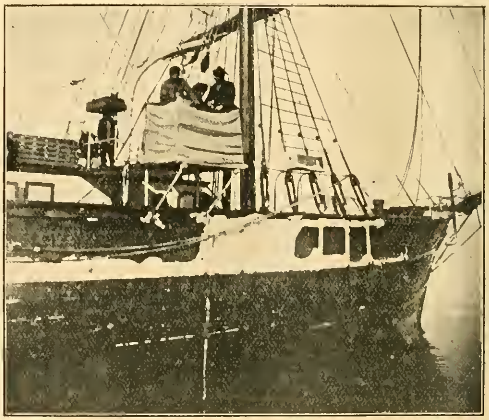


FIG. 1.—*Scotia* sounding in supposed Ross Deep 68° 32′ S., 12° 49′ W., on March 23, 1904.

The most important facts brought to light in the course of the sounding and exploring work are those connected with the discovery of Coats Land, and the final removal from the map of the "Ross deep," in which the *Erebus* and *Terror* reported 4000 fathoms no bottom. The supposed coast-line of the Antarctic continent south-east of the Weddell Sea has hitherto been placed in about 80° S. lat., probably because of the belief, to which certain temperature observations seemed to give support, that Ross's sounding was really correct. The *Scotia* discovered Coats Land in 72° 25′ S., 17° 27′ W., and skirted the coast for 150 miles. Within 2 miles of the assigned position of Ross's sounding (68° 32′ S., 12° 49′ W.) the *Scotia* touched bottom in 2660 fathoms, and the sounder brought up a large sample of blue mud. "Thus," as Mr.

Bruce puts it, "after more than sixty years of doubt, Ross Deep was removed from the map, and all the bathymetrical maps based upon this sounding were no longer of any practical use. It is interesting to contrast the methods of sounding employed on the two occasions by comparing Mr. Bruce's photographs, which we reproduce, with the illustration given in Ross's book. Another discovery of great importance is that of a ridge showing a continuation of the "South Atlantic rise" a thousand miles further south than it was previously known to exist. There is thus a ridge "extending in a curve from Madagascar to Bouvet Island, and from Bouvet Island to the Sandwich Group, whence there is a forked connection through the South Orkneys to Graham's Land, and through South Georgia to the Falkland Islands and South American continent." . . . "Antarctica, South America, and Madagascar, become connected with one another in a most direct manner by this 'rise.'" Basing his arguments on these discoveries, Mr. Bruce strongly opposes Sir Clements Markham's theory, set forth in his recent address to the Royal Geographical Society, that the Antarctic area consists of two land masses of unequal size, Victoria Land and Edward VII. Land, separated by a great barrier of ice, and of two seas extending far to the south, the Ross Sea and the Weddell Sea.

Fig. 2.—*Scotia* beset in heavy ice in 74° 1′ S. off Coats Land. The shearlegs show the position of the baited trap in 161 fathoms.

Fig. 3.—Meteorological Instruments at Scotia Bay.

The papers by Dr. Harvey Pirie and Mr. Mossman contain many points of great interest, although in the nature of things the material collected requires further elaboration, and comparison with that of the other expeditions, before its full value becomes apparent. Dr. Harvey Pirie's observations give much additional information bearing on the variations in the relative amounts of diatoms in the surface waters and in the deposits, and the remarkable differences in the meteorological values for 1903 and 1904 enable Mr. Mossman to draw many important conclusions as to the factors controlling the climate. Mr. Rudmose Brown gives an interesting account of an island which has, curiously enough, remained unexplored until now, although it lies almost on the track of sailing-ships outward bound *viâ* the Cape of Good Hope.

THE PERCY SLADEN EXPEDITION IN H.M.S. SEALARK.

I HAVE just received the accompanying communication from Mr. Stanley Gardiner, bringing the account of his expedition to September 12, the date of his letter. The letter is written from Coetivey. I may remind readers of Nature that his former communications appeared in the issues of August 10 and October 5. A. Sedgwick.

Zoological Laboratory, Cambridge, October 23.

Since my last letter Cooper and I have had a tour round the reefs of Mauritius, and have for the last three weeks been working between the latter island and the Seychelles Group. The Mauritius reefs vary from fringing to barrier, the best example of the latter being at Grand Port, where it is four miles from the land. It has there a few small islets of somewhat metamorphosed coral-rock, varying up to 40 feet high. At first it seemed as if they might have been formed by hurricanes and blown sand, but we discovered the same rock in the immediate vicinity overlying a basalt, 70 feet above the water. The present islets probably represent the remains of a considerable island, elevated for at least 100 feet, extending along that part of the barrier reef.

Leaving Mauritius on August 21, we had three days' dredging and sounding off its reefs. The contour is the same as that off atoll-reefs, a gradual slope to 40 fms. (fathoms), succeeded by a steep to 150 fms., then tailing off in five miles to 1000 fms. The bottom at 150 fms. was covered by heavy blocks of coral from the reef above. At 300 fms. we found shell and small pieces of coral, and further out a bottom of bare coral mud, sweepings from the reef and land.

Between Mauritius and Cargados there was a depth of 1062 fms., there being no marked connecting ridge, though the bottom tails off very gradually from each bank. At Cargados we remained for six days, examining the reefs and islets, and dredging. It is a crescentic-shaped surface reef, 31 miles long, on the south part of the Nazareth Bank, which is roughly 220 miles long by 60 broad, with an average depth of 33 fms. The land is of coral rock with no signs of elevation, and is a great breeding resort for tern. It is covered with guano, owing to which the land flora is very scanty, only 18 different plants being found. Naturally land animals were scarce, but 42 insects were secured, four-fifths from the guano.

Cooper for the most part took the dredgings, and he reported to me that he found near Cargados "a wonderfully constant depth of 30–35 fms. over the body of the bank, while towards its western edge there is a slight but uniform rise to 27 fms., thus suggesting an incipient atoll with its eastern side slightly tilted up above its western. Over the plateau, where 30 hauls were made in different directions, the bottom was either coral-rubble, white sand, shell-rubble, or weed. The three latter occurred only in the central parts of the bank, while the coral-rubble, though also found there, alone formed the raised edge of the western side, being mostly in the form of large lumps. From this rubble, which is of a bright red colour due to an encrusting nullipore, we obtained a rich variety of animal life, nearly all forms tinted with red. The absence of living corals from the rim as well as from the plateau in all depths over 20 fms. was a noticeable feature." About 25 different species of algæ (not lithophytes) were dredged, several from 40–50 fms. on the outer slope, though none have so far been secured from more than 60 fms.

In the channel midway between Nazareth and Saya de Malha banks we found a depth of 222 fms., the connection being a ridge rapidly tailing off on its western side to more than 800 fms. Saya de Malha itself really consists of three banks, a northern, a very large central, and a small south-eastern. The north bank we found to be separated by a channel of 636 fms. from the central, while the depth between the latter and the southern bank is only 130 fms. All are of more or less atoll form, but the south side of the central bank differs from all other parts of the same banks and from the Nazareth Bank in tailing off *very gradually* from 65 fms., the general depth in its centre, to 200 fms. The area in this part beyond 120 fms., which is to some degree protected from the prevailing south-east winds and currents, formed a rich collecting ground, the bottom being composed of a white rubble of bivalve and sea-urchin shells, evidently all swept off the shallower bottom above. From 80 to 100 fms., where it is more exposed, the bottom is hard, being swept bare by the currents, but still further north at 60 fms., where the eastern edge of the bank has only 10–20 fms. of water, is soft mud with casts of pelagic foraminifera. A considerable number of dredgings were taken at depths above 20 fms., and fair collections have been obtained. Only the regular deep-living corals were secured, but two hauls at 26 and 29 fms. gave between them more than 20 species of corals, typical of shallow reefs. To the north of the banks we dredged between 300 and 500 fms., the bottom being of the usual character at such depths off coral reefs, though with rather more rubble.

Leaving the Saya de Malha banks we ran a line of soundings to the shallow bank, which surrounds the Seychelles, the greatest depth found being 961 fms. Thus our soundings prove the existence of a crescentic-shaped ridge, 1100 miles long, with less than 1000 fms. of water, arising on either side from a general depth of 2200 fms.

Now we are at Coetivy, the most southerly island of the Seychelles Group. It is an atoll bank with a large island to the east, where we shall camp for ten days, while the ship goes to the Seychelles for coal. On her return we propose to examine the line connecting the Seychelles to Madagascar. J. STANLEY GARDINER.

September 12.

SOME CHARACTERISTICS OF AMERICAN UNIVERSITIES.[1]

THE total amount of private benefactions to university education in the States during the last thirty years reaches the amazing figure of forty millions sterling; and this is quite apart from the large annual appropriations made by the Federal Government and by the State Governments for technical colleges and State universities. The total amount contributed by private benefactions in the same period in these islands was about five millions.

The number of professors, lecturers, and other teachers in the American universities and institutions of university standing is very little short of the total number of university students in the British Isles; the figures are respectively 17,000 and 20,500.

A large and increasing number of the greatest industrial and commercial firms in America restrict their highest posts to college graduates. In Montreal two great railway companies the Canadian Pacific and the Grand Trunk have just clubbed together to establish and endow in McGill University a department of railway engineering for training the first-rate staff of officials, which they feel to be indispensable to the rapid extension of their lines in the great north-western territories now awaiting development. Of our own industrial leaders, it would be safe to say that at least nine out of ten would regard a college training as an absolute disqualification.

The vigour of the professional schools is to be explained by two features which differentiate them from our own:—(1) The presence of a culture element; (2) the close and almost organic connection between academic and industrial life.

(1) Where a professional or higher technical school is established in England, the tendency is to make it purely technical, to banish all literary studies, and confine the student's attention strictly to scientific study directly bearing on his future profession. In America a broader view is taken.

The great Morrell Act for agricultural and mechanical colleges was thus expounded by its author:—"These colleges were not established for the sole purpose of teaching agriculture. It was never intended to force the boys of farmers going into these institutions so to study, that they should all come out farmers, but to give them an opportunity to do so if they saw fit. Secondly it was a *liberal education* that was proposed. Classical studies were not to be excluded, and must therefore be included."

But further, the technical course itself in the great majority of cases includes a culture element, supplied not by Latin and Greek, but by French or German, history, civics, and economics. The Massachusetts Institute of Technology in Boston, the greatest school of the kind on the Continent, the Pratt Institute (Brooklyn), the Armour Institute (Chicago), all make literary studies of this kind an indispensable part of the curriculum for their diplomas. The same is true of the great Guelph College of Agriculture in Ontario: French, German, and English literature have to be studied before the student can graduate as B.S.A. of the University of Toronto; and the reason was well put by the principal:—"It is not sufficient that our graduates should know their professional work, they must have some knowledge of their fellow-men and power of holding their own and of presenting their subject to the educated public, which a purely technical training cannot give." These are the words of a remarkable man who found Guelph in 1884 on the verge of extinction, and in twenty years has raised it to a position of almost undisputed primacy among the agricultural colleges of the continent, and transformed thereby the agricultural industry of central Canada.

(2) Both professors and students are in the closest touch with the industry which the school is intended to feed. The former are not merely permitted, but encouraged to take private outside work. The latter are required to spend some part at least of their vacations in working in mines, engineering works, on farms, &c., as the case may be, and their reports on the work thus done contribute

[1] Abridged from an address delivered before the Guild of Graduates of the University of Wales at Aberystwyth, by Principal H. R. Reichel.

to form the professors' estimate of their fitness for the degree.

The universal length of the undergraduate course is four years, not three as with us; and I am bound to say the lengthened period seems to me to have a decided advantage in avoiding hurry and encouraging maturity of growth. For several years the doubt has been growing in my mind whether our qualifying period of three years can be regarded as satisfactory. We owe it, no doubt, to the habit of mind inherited from the old London University of regarding ability to pass a written examination as the true test of training. From this incubus the American university is almost wholly free. A student gets his degree for the regular work he does throughout his university course, and though there is a test at the end, that test hardly ever takes the form of a cumulative examination in all he has been studying for two or three years; often it is a thesis. The effect of this on the course of study is very marked.

Post-graduate study is of comparatively recent growth in the States, and largely the outcome of the foundation and development of the Johns Hopkins University.

Like the Owens College in Manchester, Johns Hopkins owes its origin to the philanthropy of a wealthy merchant of Welsh descent. Its peculiar character, however, is due to the academic prescience and statesmanship of its first president. He saw that there were plenty of universities and colleges of the ordinary undergraduate type, and that what the country really needed was a university for "graduate study," which at that time could only be secured by going to Germany.

The method of teaching is based on that of the German seminar, of which it has adopted the name, but it provides for more constant and systematic intercourse between professor and student. While the German seminar meets weekly, the American meets every day, and the student receives far more individual attention. The course again is more exacting, the minimum length being three years, and the average four and a half, starting, be it remembered, from the completion of the B.A. degree. The aim is to train in methods of original investigation—in short, as it was well put to me by one of the professors, "to transfer to literary studies the methods of higher work in science." The work is based on the preparation of the student's dissertation for the doctorate. At every stage, first in outline and subsequently in complete form, the dissertation is discussed section by section, chapter by chapter. Each department of study has its own seminar room furnished with a departmental reference library. The arrangement is not that of the lecture theatre, which implies an orator and an audience, but rather that of the committee room with a chairman and a ring of debaters. The class, which would never exceed from twelve to fifteen, sits at an oblong table, the professor, so to speak, occupying the chair of the meeting at one end. Round the walls at their backs are the shelves containing books of reference, often running to several thousand volumes, and these, it should be noted, are quite independent of the central university library.

This seminar study was at first the sole, and is still the main, work of the university, and that which has made the name of Johns Hopkins famous throughout the civilised world. An age more given to omens might have seen in the remarkable fact that in the gigantic conflagration which recently swept away the centre of the city of Baltimore, the university was the only public institution the buildings of which escaped scot free, a tribute of the powers of nature to the unique position it holds in American academical life. Its influence on higher study through the whole North American continent has been rapid and profound. It is not merely that a large number of distinguished specialists has been produced whose labours have raised the level of American learning; post-graduate study has become the ambition of the American university, and more and more is being accepted as that which differentiates it from the mere college. There are few universities now which have not their seminar rooms and departmental libraries, though it must be admitted that in many cases these are at present only utilised for undergraduate study of the third and fourth years. But the growth in post-graduate work since Johns Hopkins was founded has been fairly staggering. In 1871 there were only 198 post-graduate students in the States; twenty-five years later the number had risen to 4919, or very nearly one quarter of the total number of university students of all classes in the British Isles.

The great bulk of those who win the Johns Hopkins doctorate naturally become university professors and lecturers. At the same time there is a rapidly increasing demand for them from the high schools, which are all organised on the basis of specialist teaching in each department. The evidence, both at the schools and the universities, supports the view that the Ph.D. candidate for a school post would have the advantage over a B.A. who had also been through a course of training in teaching, and would command a higher salary, and that this tendency is on the increase. It is felt that the man whose knowledge is deepest is likely to make the best teacher, and that lack of pedagogic skill at the start will be made up for in the long run by greater inspiration.

The system of our own older universities—at least of Oxford—is, it must be confessed, less favourable to post-graduate work. The explanation is to be found largely in the difference of the undergraduate course. The American university has no "honours" schools for the initial degree in which the energies of the best men are devoted rather to amassing the results of other people's investigations over an immense area than to cultivating the power of acquiring knowledge by their own. One of my fellow commissioners, who had examined at Cambridge in the law tripos, and bears a name of European reputation, told me he was often perfectly "horrified" by the amount the young men knew; such a mass of knowledge must have a most deadening effect on intellectual vigour. Thus, while the actual attainment at the initial degree is by no means so high as at Oxford and Cambridge, at all events for the best students, there is a far truer conception of learning, and an enormously larger proportion of men go on to higher work and research. In my visits to the universities the question was repeatedly asked of me, "What kind of men should we select for the Rhodes scholarships?" My answer has always been, "By all means, send us graduates. Undergraduates will do Oxford little good, and may get out of touch with American life; graduates will gain a wider experience without being de-americanised. Nothing, at the same time, would do so much for the revival of higher study at Oxford as a steady supply of picked graduates of an inquiring type." "But does Oxford want graduates?" has been the usual reply. "The experience of many men we know who have been there is that it is practically impossible to get assistance for post-graduate work; after a short trial they have generally gone on to Germany." The justice of the criticism it is difficult to question. Though the University of Oxford has created special post-graduate degrees in order to attract graduates of other universities for advanced study or research, the Oxford college with its pot-hunting instincts stands in the way. It makes, or thinks it makes, its name by the number of first classes won by its undergraduates, and will, therefore, give no encouragement to the higher learning which our Philistine upper class neither understand nor care for. I have known a case where the whole tutorial influence of a college was used to prevent one of its scholars competing for a university prize essay involving original research. It was not denied that the work might be intellectually better for him, but then it might endanger his "first." The scholar, I am glad to say, had the strength of mind to take his own line, and gained the prize.

Let me conclude with a word about the ideals of the students and their attachment to their old college or university. I have said that the course is never less than four years; when I add that there are hardly any scholarships and that a large proportion of the students are distinctly poor, you will doubtless ask how they manage to do it? This brings me at once to what I unhesitatingly affirm to be the most admirable feature of life on the other side of the Atlantic, whether in the States or in Canada, viz. the entire absence of the feeling that honest work of any kind can be derogatory to an educated man. The American and Canadian student whose friends

cannot afford to keep him at college, pays his way either by working during the long vacation in all sorts of manual employment or by rendering what we should regard as menial services to his fellow-students during term time, much like the old "servitors" at Oxford and Cambridge. Nor does this create any social barrier. At one university visited by some of my Mosely colleagues they were waited upon during the college dinner by some very intelligent looking young fellows, and found on inquiry that these were students. Somewhat surprised at this, one of the party asked if this would not tell against them socially. "Not in the least," was the answer. "That man over there is president of one of the chief debating societies; that other is one of our best athletes and much looked up to." It is the same in the women's colleges. At Vassar one girl keeps a bicycle cleaning shop; they act as room-tidiers, clean shoes, &c. In Canada I was informed that at Queen's University, Kingston, no less than 70 per cent. of the men students earn their fees and maintenance for the coming session by working through the summer on farms, on the railway, in mines, river steamboats, &c. The fact is, the Transatlantic youth is rather proud of being able to earn his own living; it makes him feel himself more of a man, and it is not at all uncommon for the son of rich parents to take work in this way for the sense of independence it brings. It is a fine spirit, and makes one blush when one thinks how very different a reception such conduct would probably meet with over here.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The committee for the supervision of instruction in geography has appointed Dr. A. J. Herbertson, director of the school of geography, for the remainder of the term of five years for which the grants to the school of geography have been voted. A syllabus of the examination for the diploma in this subject has been issued, which includes regional geography, climatology and oceanography, geomorphology, historical geography, and surveying.

The delegates of the common university fund have elected Mr. G. W. Smith, New College, to the biological scholarship at Naples for the year 1905–6.

Mr. M. H. Godby has been elected to a Dixon research scholarship in chemistry at Christ Church.

CAMBRIDGE.—An interesting insight into the way the university is governed is given by the following figures. A careful analysis of the poll-book of the recent vote on "compulsory" Greek gives the following results:—(1) Of the residents, 288 voted in favour of the recommendation that Greek should no longer be compulsory in the previous examination; 240 voted against the recommendation—majority of residents in favour of the recommendation, 48. (2) Of the total number of members of the senate who voted, residents and non-residents included, 1591 were laymen, 1021 were clergymen. Of the laymen, 923 voted in favour of the recommendation; 668 voted against it—majority of laymen in favour of the recommendation, 255. Of the clergymen, 132 voted in favour of the recommendation; 889 voted against it—majority of clergymen against the recommendation, 757.

The report on the proposed diploma of forestry was discussed on Thursday, November 2. Among the speakers were the professor of geology, the professor of botany, the secretary of the financial board, and the master of Gonville and Caius College. The proposal was warmly welcomed.

The State medicine syndicate reports that last year seventy-one candidates presented themselves for the diploma in public health, and that twenty-four candidates entered for the diploma in tropical medicine and hygiene, sixteen of whom were successful.

The following have been nominated examiners for the natural science tripos in 1906:—in physics, Mr. R. T. Glazebrook and Mr. C. T. R. Wilson; in chemistry, Mr. H. O. Jones, and Mr. H. B. Baker, Oxford; in mineralogy, Prof. Lewis, and Mr. H. L. Bowman, Oxford; in geology, Mr. P. Lake and Dr. F. A. Bather; in botany, Mr. A. C. Seward, and Mr. A. G. Tansley, of University College, London; in zoology, Mr. A. Sedgwick, and Prof. MacBride, of Montreal; in physiology, Mr. W. M. Fletcher, and Prof. T. G. Brodie, of the Brown Institute; in human anatomy, Dr. Barclay Smith, and Dr. A. Robinson, of Birmingham University.

The Vice-Chancellor announces that Sir Archibald Geikie will, on behalf of the board of geographical studies, deliver a public lecture in the Sedgwick Museum on November 21, at 5 p.m., on "The Evolution of a Landscape." On the evening of the same day, and at the same place, Dr. C. Hose, of Sarawak, will lecture on Borneo.

The next combined examination for sixty-two entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel colleges will be held on Tuesday, December 5, and following days, commencing at 9 a.m. on December 5. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Scholarships and exhibitions will also be offered for history, for modern languages, and for Hebrew at some of the colleges. A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1905. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, Mr. W. S. Hadley; Gonville and Caius College, the Master; King's College, Mr. W. H. Macaulay; Jesus College, Mr. A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, Dr. Donald MacAlister, Dr. J. R. Tanner, Mr. E. E. Sikes; Emmanuel College, the Master; from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained. The forms of application must be sent in on or before Tuesday, November 28.

MR. F. S. PINKERTON has been appointed professor of applied mathematics at the University College of South Wales, Cardiff.

BY the will of Mr. J. E. Williams, of Chester, who died on July 15, a legacy of 10,000*l*. is bequeathed to the University of Wales, the income to be used in founding new scholarships and prizes in his name, to be held upon certain terms and conditions. In the event of the University of Wales not accepting the legacy within six months, the same is to be paid to the trustees of the University College of North Wales at Bangor upon the same conditions. He also bequeathed 10,000*l*. to the University College of North Wales at Bangor upon the same conditions, and 2000*l*. for the building fund of this college.

AT the last meeting of the council of the University of Birmingham, the Vice-Chancellor (Alderman C. G. Beale) in the chair, the Chancellor (Mr. Chamberlain) announced that a friend of the university, who desired to remain anonymous, had promised a donation of 50,000*l*., the amount to be applied towards the completion of the new buildings at Bournbrook. The council desired the Chancellor to convey its best thanks to the generous donor for his munificent gift. This is the fourth amount of 50,000*l*. already contributed to the university endowment fund, the other sums having been received from Mr. Andrew Carnegie, Sir James Timmins Chance, and an anonymous donor. The total fund is about 450,000*l*., to which must be added annual contributions from the City Council (6000*l*. per annum), and 500*l*. each from the county councils of Staffordshire and Worcestershire. The council has already approved of expenditure upon the site and buildings amounting to about 280,000*l*., in addition to upwards of 80,000*l*. on equipment. It is hoped that a formal opening of the new buildings may be possible in about eighteen months' time.

THE Board of Education has issued the following list of candidates successful in this year's competition for the Whitworth scholarships and exhibitions:—(1) *Scholarships*, 125*l*. a year each (tenable for three years): H. Topham, Grantham; C. W. Price, Devonport; W. F. Paffett, Portsmouth; R. W. Bailey, Goodmayes (Essex). (2) *Exhibitions*, 50*l*. (tenable for one year): W. White, Southsea;

A. E. Humber, Portsmouth; G. Lees, Southsea; A. Ward, London; A. W. Sawyer, London; C. E. G. House, Chatham; H. Schofield, Halifax; J. M. Robertson, Pembroke Dock; W. E. G. Sillick, Devonport; J. A. Cormack, Glasgow; F. Clements, Chesterfield; B. J. Cole, Devonport; P. W. M. Sparey, London; S. Lees, Manchester; B. H. Penn, Bedford; W. H. Stock, Swindon; W. R. Sinclair, Newcastle-on-Tyne; M. Bell, Bensham, Gateshead; T. H. Essery, Devonport; S. H. Warren, Devonport; A. R. Valon, London; G. R. Wilkinson, Oldham; A. D. Johnston, jun., South Shields; W. C. A. Bowles, London; A. L. Bird, Cambridge; T. N. Adlam, Trowbridge; J. Bedford, Chingford; P. P. Smart, Wolverton; C. L. Gransden, Chatham; W. F. Brown, Birkenhead.

THE following list of successful candidates in this year's competition among science students for Royal exhibitions, national scholarships and free studentships has been issued by the Board of Education:—*Royal exhibitions:* Arthur B. Middleton, Bradford, Manchester; William White, Southsea; Alfred E. Humber, Portsmouth; George Lees, Southsea; Frederick E. Pollard, Eastwood, Notts; James L. Kent, Portsmouth; Frank Fielden, Halifax. *National Scholarships for Mechanics (Group A):* Arthur T. Wall, Plymouth; Arthur Cannon, Plymouth; William E. Dommett, Southsea; Herbert J. London, London; Charles E. G. House, Chatham; William E. G. Sillick, Devonport. *Free Studentships for Mechanics (Group A):* Charles L. Gransden, Chatham; Harford G. Stephens, Leicester. *National Scholarships for Physics (Group B):* John M. Strang, Glasgow; Frederick Reid, Glasgow; John W. Waters, Chatham; Dudley Orson-Wood, Chiswick; George F. Hemens, London; William F. Higgins, London; Walter C. M. Pettingill, Leeds. *Free Studentships for Physics (Group B):* Frederick J. Harlow, Whitstable; Edward F. Pattenden, Whitstable. *National Scholarships for Chemistry (Group C):* Harry F. V. Little, London; Tom Thornley, Blackburn; Samuel Lamb, Bradley, Bilston; Alan C. Webber, Brighton; John H. Jennings, Plymouth; Robert O'F. Oakley, London. *Free Studentships for Chemistry (Group C):* Archibald Wise, Plymouth; Charles S. Garland, London. *National Scholarships for Geology (Group E):* John W. Maxfield, Burnley; Ernest Proctor, Burnley; James Mitchell, Burnley.

THE annual general meeting of the Association of Teachers in Technical Institutes was held at the Birkbeck College, London, on November 4. The association, which was founded a year ago, already has a membership of 300 exclusive of the Association of Teachers of Domestic Sciences, which is affiliated with it. Mr. W. J. Lineham, the president, was in the chair, and moved the adoption of the report of the council, which was subsequently agreed to. The council recommends in the report that meetings of teachers in provincial technical institutes be called to lay the claims of the association before them directly. A resolution was passed instructing the council to call meetings of the teachers in provincial technical institutes and to consider the following matters with full powers to act therein:—(*a*) The formation of local or provincial branches of the association; (*b*) joint action or federation with the West Riding Association of Teachers of Science, Art, and Technology, the Federation of London Teachers, and other bodies of teachers. One of the most important matters discussed during the year has been the registration of teachers. A scheme has been drawn up by the council, and a circular has been issued to members pointing out its importance upon the future *status* and professional position of teachers in technical institutes. A scheme for registration has already been formulated by the teachers of domestic science. The council recommends that steps be taken at an early date, by deputation or otherwise, to urge upon public examining authorities the importance of securing closer connection between the examiner and the teacher. Various amendments to the constitution and rules were decided upon, and the title of the association was changed to that of "The National Association of Teachers in Technical Institutes," and it was resolved that its officers be a president, two vice-presidents, an hon. secretary, and an hon. treasurer. Mr. Lineham was elected president for the ensuing year.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 27.—Prof. J. H. Poynting, F.R.S., president, in the chair.—The theory of phasemeters: Dr. W. E. **Sumpner.** The author shows in the paper that the theory of the instruments is the same whether they contain iron or not, and however the coils may be arranged; that they can be calibrated by direct-current methods, although for use on alternating-current circuits; and that a new type of instrument, containing iron, conforms to the theory given. The main results of the investigation are:—(1) Phasemeters for multi-phase circuits are all equally accurate on balanced loads provided they have been correctly calibrated and possess no faults due to purely mechanical causes. Their accuracy is not affected by variations in wave-form or in current-frequency. (2) Phasemeters can be simply and accurately calibrated for balanced loads by means of a direct-current method of test. (3) The error of phasemeters on unbalanced circuits is generally serious for loads which are badly out of balance. The error, like that of a wattmeter, increases rapidly as the power-factor of the load diminishes. It can only be reduced at the expense of complication in the instrument, by increasing the number of coils used in the fixed and moving systems, and by arranging the coils and magnetic circuits to be symmetrical in regard to one another.—Apparatus designed for measuring the coronal radiation during an eclipse: Prof. H. L. **Callendar.** A preliminary test of the apparatus with the thermopile directly exposed to radiation of known intensity showed a deflection of nearly 25 cm. for one-thousandth of a calorie per sq. cm. per min., so that radiation one-millionth of full sunshine could be detected with certainty without using a mirror. When placed in the focus of the telescope used, radiation one thousand times smaller than this could be observed, so that even if the intrinsic heat-radiating power of the corona were only one ten-millionth of the solar surface it could still be measured to within 1 per cent. The essential point in the observations was to eliminate the variable effects of atmospheric radiation, for which a differential method of observation with the two halves of the pile was particularly suitable. In taking observations on the corona, the motion of the moon during totality was made use of to define the exact area of the corona corresponding to the differential reading. At the commencement of totality, the thermopile being centred on the sun, the inner corona on the eastern limb would be fully exposed, while on the western it would be partly covered by the moon. At the end of totality the reverse would be the case. The difference of the readings would correspond to the radiation of the strip of the inner corona uncovered by the motion of the moon between the two readings. The area of the strip of corona considered could be accurately determined from the times at which the readings were taken.

PARIS.

Academy of Sciences, October 30.—M. Troost in the chair.—Two hæmatozoa of the partridge and turkey: A. **Laveran** and M. **Lucet.** The first of these was the cause of the death of 97 out of 100 Hungarian partridges imported into France. Its appearance and mode of division corresponded with *Haemamoeba relicta*, a parasite which has been known to be responsible for epidemics in many birds, but not hitherto of the partridge. The other parasite, found to be the cause of perityphlo-hepatitis in the domestic turkey, appears to belong to a new species, and is named *Haemamoeba Smithi.*—A criterion for the application of the Gompertz-Makeham mortality law: Charles **Goldziher.** The application of this law depends absolutely on the regularity of the original series, but, so far, an exact criterion for the exactitude of the limits between which this application is possible has been wanting. This is worked out in the present paper.—On the composition of the hydrochloroferric colloid with respect to the amount of hydrochloric acid present in the suspending liquid: G. **Malfitano.** By increasing the concentration of the medium in hydrochloric acid, the colloid tends to approximate to the composition $H(Fe_2O_6H_6)Cl$.—Observations relating to some india-rubber plants: A. **Chevalier.** Whatever may be the family to which a caoutchouc belongs, its richness

in india-rubber is an individual peculiarity. The yield may be very different in two individuals of the same age and of the same size, living side by side, and having the latex extracted at the same time. The influence of different kinds of light radiations on the migration of the albumenoids in the wheat grain: J. **Dumont.** It was found that the radiations which have the greatest effect on the migration of the albumenoids in the wheat grain are precisely those which act the least on the chlorophyll function.—On the mechanical work furnished by windmills: M. **Ringelmann.** The windmill studied was of the type used in agriculture for raising water. Automatic records were made of the velocity of the wind, the number of turns of the vane, and of the water lifted. A table of results for different velocities of the wind is given, and from this the work obtainable from a windmill can be calculated.—The accessory glands to the silk-producing apparatus of the larvæ of *Io Irene*: L. **Bordas.** The liquid or slightly viscous substance secreted by the accessory glands serves to agglutinate or unite the two silk threads. It is possible, also, that it exerts a chemical action on the threads, causing them to harden rapidly.—On the existence of strata containing Clymenia in the central plateau, Morvan: Albert **Michel-Lévy.**—On the dissymmetry of the loss of electricity in mountainous countries: the comparative *rôles* of height and relief: MM. Bernard **Brunhes** and Albert **Baldit.** At the summit of a mountain the rate of loss of volts is greater for negative than for positive electricity. These results serve to show why several authors have been led to think that passing from the plain to a mountain leads to a great exaggeration of the loss of negative electricity.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 9.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting—The Continuum and the Second Number-class: G. H. Hardy.—On the Arithmetical Nature of the Coefficients in a Group of Linear Substitutions of Finite Order (second paper): Prof. W. Burnside.—On the Asymptotic Value of a Type of Finite Series: J. W Nicholson.—On an Extension of Dirichlet's Integral: Prof. T. J. I'A. Bromwich.—(1) On Improper Multiple Integrals; (2) On the Arithmetic Continuum: Dr. E. W. Hobson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address: John Gavey, C.B.

FRIDAY, NOVEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) Observations of the Satellite of Neptune from Photographs taken between Nov 11, 1904, and April 15, 1905; (2) Micrometric Measures of Double Stars made with the 28-inch Refractor in the Year 1904: Royal Observatory, Greenwich: Communicated by the Astronomer-Royal.—(1) On the Secular Acceleration of the Earth's Orbital Motion: (2) On the Ptolemaic Eclipses of the Moon recorded in the Almagest: P. H. Cowell.—Observations of Phenomena of Jupiter's Satellites made at Windsor, New South Wales, in the Years 1900 and 1902: John Tebbutt.—On the Corrections to Hansen's "Tables de la Lune," as deduced by Mr. Cowell: E. Nevill.

PHYSICAL SOCIETY, at 8—The Question of Temperature and Efficiency of Thermal Radiation: J. Swinburne.—Note on Constant-Deviation Prisms: T. H. Blakesley.

MALACOLOGICAL SOCIETY, at 8.—(1) Descriptions of New Species of Drymæus, Amphicyclotus, and Neocyclotus from Central and South America; (2) Description of a New Species of Achatina from Mashonaland: S. I Da Costa.—On a Collection of Land and Freshwater Shells from Sumatra with Descriptions of New Species, part i.: Rev. R. Ashington Bullen On a New Species of Oliva: F. G. Bridgman.—On the Anatomy of *Ensis macha* and *Solen fonesii* and *S. viridis*: H. H. Bloomer.

TUESDAY, NOVEMBER 14.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Waterways in Great Britain: J. A. Saner.

ZOOLOGICAL SOCIETY, at 8.30.—On the Papillary Ridges in Mammals, chiefly Primates: Dr. Walter Kidd.—On a Collection of Mammals brought home by the Tibet Frontier Commission: J. Lewis Bonhote.—Note on the Geographical Distribution of the Okapi: Dr. Einar Lönnberg.—Notes on Goral found in Burma: Major George H. Evans.—The Mammals of Crete: Dorothea M. A. Bate.

MINERALOGICAL SOCIETY, at 8.—The Determination of the Angle between the Optic Axes of a Crystal in Parallel Polarised Light: Dr. J. W. Evans.—(1) On a Tabular Crystal of White Diopside; (2) On a Carlsbad-twin of Albite: Prof. W. J. Lewis.—Note on the Crystallisation of Drops, especially of Potash-Alum: J Chevalier. Note on the Formation of Gypsum Crystals in a Disused Well at Chemical Works: C. J. Woodward.—(1) Ilmenite from the Kollergraben, Binnenthal; (2) On a New Red Cubic Mineral; (3) On Seligmannite, Marrite, and Lengenbachite from the Lengenbach Quarry; (4) On Anhydrite and other Minerals found in the White Dolomite of the Simplon Tunnel: R. H Solly.

WEDNESDAY, NOVEMBER 15.

SOCIETY OF ARTS, at 8.—Opening Address of the Chairman of the Council, Sir Owen Roberts.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Rainstorm of August 24–26, 1905, in Co. Dublin and Co. Wicklow: Sir J. W. Moore.—The Aquameter: Dr. W. B. Newton.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Exhibition of Microscope Slides of Tsetse-Fly Dissectinns, Trypanosomes, etc.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—The Physical and Chemical Properties of Iron Carbonyl: Sir James Dewar, F.R.S., and H. O. Jones.—The Transit of Ions in the Electric Arc: A. A. Campbell Swinton.—First Photographs of the Canals of Mars: Prof. Percival Lowell.—On the Laws of Radiation: J. H. Jeans.—The Pressure of Explosions. Experiments on Solid and Gaseous Explosives: J. E. Petavel.—On Newton's Rings formed by Metallic Reflection: Prof. R. C. Maclaurin.—The Accurate Measurement of Ionic Velocities: Dr. R. B. Denison and Dr. B. D. Steele.

CHEMICAL SOCIETY, at 8.30.—Silicon Researches, Part ix., Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (SiN): J. E. Reynolds.—Condensation of Ketones with Mercury Cyanide: J. E. Marsh and R. de J. F. Struthers.—Application of the Microscopic Method of Molecular Weight Determination to High Boiling Solvents: G. Barger and A. J. Ewins.—Green Compounds of Cobalt produced by Oxidising Agents: R. G. Durrant.—Synthesis of Tertiary Menthol and of Inactive Menthene: W. H. Perkin, Jun.—Optically Active Reduced Naphthoic Acids, Part i., Dextro-$\Delta^{(2 \text{ or } 3)}$-dihydro-1-naphthoic Acid: R. H. Pickard and A. Neville.

LINNEAN SOCIETY, at 8.—Contributions to the Embryology of the Amentiferæ: Dr. Margaret Benson, Elizabeth Sanday and Emily Berridge.—On the Ears of certain Sharks: Prof. Chas. Stewart, F.R.S

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Seventh Report of the Alloys Research Committee; On the Properties of a Series of Iron Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, R. A Hadfield, and P. Longmuir.

CONTENTS.

THURSDAY, NOVEMBER 16, 1905.

"*MATHEMATICS*" *APPLIED TO CHEMISTRY.*

Researches on the Affinity of the Elements, and on the Causes of the Chemical Similarity or Dissimilarity of Elements and Compounds. By Geoffrey Martin. Pp. xii+287. (London: J. and A. Churchill, 1905.) Price 16*s.* net.

THE word "mathematics" has been placed in the title of this review in inverted commas, because, although the mathematical formulæ employed appear to be formally correct, the application of mathematical formulæ to the data collected in Mr. Martin's work appears to the reviewer to be unjustified. To demonstrate this a sketch of Mr. Martin's scheme is necessary.

Mr. Martin's endeavour is to find for each element, and, if desired, for each compound, a formula which will express its affinity for all other elements and compounds, so that it may be possible, in his own words, "to discover the law regulating the chemical attraction the elements mutually exert on each other"; and this is achieved, according to him, by "the construction of some geometrical figure which will quantitatively pourtray the chemical properties of the element."

The plan adopted is to arrange the elements into series and columns, as in the usual periodic diagram; the group numbers are plotted along a horizontal ordinate OX, and the series numbers along an ordinate at right angles to the former, OY. There are ten points along OX, filled in the second group by the elements Li, Be, B, C, N, O, F, and Ne, and there are eleven points along the ordinate OY, occupied in the first column by the elements H, Li, Na, K, Ca, Rb, Ag, Cs, ?, ?, and Au. This, it will be seen, gives one of the common forms of the periodic table. Next, for any one element, having one definite valency (one, it may be, of several valencies which it may possess), perpendiculars are erected on the point occupied by each of the known elements, expressing by its height the affinity of that element for each of the others. Thus, choosing the element chlorine, and regarding it as monovalent, vertical lines are to be erected, showing by their length that that erected on, say, the point occupied by cæsium, expresses a high degree of affinity or attraction; the vertical on the point occupied by arsenic, for example, viewed as triad, would show by its shorter length that the affinity of chlorine for arsenic is less than it is for cæsium; a repetition of this process for all known elements produces a number of points, 10×11, or 110 in number, if all spaces are considered, or a smaller number, the number of the actually known elements, in actual practice. Mr. Martin *imagined a curved surface to be drawn through these points,* and proceeds to develop equations which will represent that surface. He shows, so far as the reviewer can see, correctly, that for the complete characteristic equation for the supposed 110 elements, each of which is supposed capable of existing in 8 degrees of valency, there are $2 \cdot 3486 \times 10^{108}$ different possibilities of associating degrees of valency! However, by a device the author mercifully lowers this number to 8448, being 64 times 132; 132 represents the number of constants for the characteristic affinity-surface for each element existing with only one of its possible eight valencies exercised.

We have italicised the words "imagined a curved surface to be drawn through these points" because there lies the crux of Mr. Martin's attempt. What reason has he to join his points? Does he imagine that the interspaces are filled by an infinity of elements of all conceivable atomic weights between the known limits 1 and 240? If not, then the whole system is discontinuous, and the characteristic surface is non-existent.

But we will accept Mr. Martin's method for the moment, and inquire how he imagines affinity to be measured, so as to obtain the lengths of his vertical coordinates. The methods of estimating comparative affinity may be taken as three in number. First, he suggests that while the "energy of combination" should be measured by the heat generated by a reaction starting from the absolute zero, such measurements are impracticable, and, *faute de mieux,* the "heats of formation" at ordinary temperatures must suffice. This method may be better realised by a concrete example. One-third of the heat evolved when boron burns in chlorine amounts to 34·7 calories; one-quarter of that of the formation of silicon chloride is 39·4 calories. These numbers are approximately equal, hence the affinities of boron and of silicon for chlorine are nearly the same. But this is not always the case; for instance, as Mr. Martin points out, $\frac{1}{4}(Si,H_4)=8 \cdot 2$, whereas $\frac{1}{4}(C,H_4)=5 \cdot 2$; yet "undoubtedly of these two bodies, the H is attracted to the C in CH_4 with a greater intensity than it is attracted to the Si in SiH_4." He therefore guards himself by the statement that "it is only when the heat evolved in the formation of a compound is very great that it can be taken as measuring approximately the attractive forces." There may be a little in this, but the reviewer has read something like it before. Second, an estimate of the relative affinity of the elements in two similar compounds may be derived from a consideration of their temperatures of decomposition. Again, that suggestion is at least a century and a half old. Third, temperatures of reaction may be made a rough measure of affinity. For instance, lead oxide is reduced by hydrogen at a lower temperature than iron oxide, hence the affinity of lead for oxygen is less than that of iron. Estimates of such affinities, and their application to the formation of curved surfaces as described, fill 206 pages of the work. Three appendices treat respectively the causes of the absence of other compounds of elements than those which contain the element at a high or at a low grade of valency; the bearing on the phenomenon of life of the critical temperature of decomposition of chemical compounds; and lastly, "the possible significance of alcohol drinking," in which the glorious hope is held out to our remote de-

scendants of a world in which, owing to a decrease in temperature below the freezing point of water, that useful liquid will be replaced by alcohol!

There is a Scots proverb running thus:—"Mickle cry and little 'oo (wool)." The amount of "wool" in this work is surely insufficient for the "cry." Yet there are some suggestive passages, and the author has evidently spent much time over his problem.

A word in conclusion as to the "get-up" of the book. The reviewer, in reading it, felt that he must act as a proof-reader. There is hardly a page on which a misprint does not occur; and such lapses as "The only data available *is* the following:"; the words *uni-* and *tetra*-valent in one line; "to completly (*sic*) picture"; and the printing of almost every sentence as a paragraph, make the reader's task an ungrateful one.

Something, no doubt, may be accomplished in course of time when affinity constants have been numerically determined (and many are already known) to show that they, too, are periodic functions of the atomic weights; but Mr. Martin has not succeeded in pointing out the lines on which this goal is to be reached.

AN ORNITHOLOGIST'S JOURNALS.

Travels of a Naturalist in Northern Europe: Norway, 1871, *Archangel,* 1872, *Petchora,* 1875. By J. A. Harvie-Brown. 2 vols. Pp. xxii+541; with coloured plates and other illustrations and 4 maps. (London: T. Fisher Unwin, 1905.) Price 3*l.* 3*s.* net.

THE journals which compose the greater part of these two handsome volumes relate to three ornithological visits paid to Norway, Archangel, and Petchora about a quarter of a century ago, and the author good-humouredly anticipates their being regarded as "stale news" or "cauld kail het again." On this score, however, there was no need for an apology, for the author tells his story for the first time (apart from previous technical reports), and, besides, the interest of a naturalist's observations depends, not on their date (provided the date be given), but on their intrinsic worth.

As Mr. Harvie-Brown is an accomplished ornithologist, an enthusiastic faunist, and the author of some delightful and valuable books on the natural history of Scotland, it goes without saying that these journals contain some interesting scientific information and some picturesque narrative. But the trouble is that to discover these oases we have to traverse what seem to us dreary deserts of trivial and commonplace monotony, and we can hardly control our impatience by remembering that there had to be many trivial and commonplace days before the author found the nesting-ground of the little stint. What is published is just what was written down at the close of each day, and it follows that items which loomed large at the moment, such as the supper menu, appear of little importance to the callous reader, as doubtless to the journalist himself in retrospect at Dunipace. He got such a gorgeous "bag" of birds—1019 skins and 1021 eggs from the Petchora hunt alone—that we can sympathise with his wish to live his hunting days on the tundra over again; we only wish that his recapitulation had not been so terribly *in extenso*. We are much interested to read how Mr. Seebohm came in one evening, "and with a triumphant thump laid on the table, first a Grey Plover, then a Snow Bunting, and then a Curlew Sandpiper; lastly, and most triumphantly—hurrah!—five Little Stints, long looked for, found at last"; but we cannot get up much enthusiasm over the bulk of the narrative.

The tour in Norway was more or less of a novelty in 1871, and much is related that is now familiar. Much has changed, but more remains the same, and one unchanging feature of which the journal affords abundant illustration is the human appetite.

The Archangel region had been but little worked by ornithologists when Mr. Harvie-Brown and (the late) Mr. E. R. Alston explored there in 1872, and they were richly rewarded. The journal becomes more interesting, though our attention is still distracted by Ernst Craemers's toothache, by the size of the packing-case for the birds, by Alston's loss of his big knife ("one made by Wilkinson, of London"), by the number of bowls of milk drunk, and so forth.

The most adventurous journey was that which Mr. Harvie-Brown and Mr. Seebohm took in 1875 to the region of the Petchora, where they were the first to find the eggs of the little stint in Europe. The author shows his powers in the graphic description of the locality and in his story of the discovery. We quote the description of the nest:—

"Rather untidy, rather rough and uneven round its rim, very shallow, sparingly lined with dry grasses and a little leaf or two, which may have been plucked by the bird as she sat in her nest. Round it, deep, spongy, but not wet, yellow moss, the dark green leaves and empty calices of the Arctic Bramble, a tuft of round-stemmed green sedge with seed; a little further off, the now flowerless plants of the sweet-scented dwarf rhododendron, and bunches and patches of long white grass and plants of a small cotton-grass, and other plants and grasses, of which we shall bring home specimens for identification."

There is a fine plate of stint's eggs, and a careful comparison of the little stint and Temminck's stint. Another beautiful plate contrasts the eggs of grey plover and golden plover.

In the course of the Petchora journal we find some notes on habits which are interesting, *e.g.* those relating to the fact that birds which do not perch, or but rarely perch, in other countries, perch in Petchora. Thus, on one occasion, by patiently following up the "tick tjuck" of the common snipe, Mr. Harvie-Brown had the satisfaction of seeing this wader "perched on the tip-top of one of the gaunt branchless blasted larches, quite 70 feet from the ground." Curlews, gulls, snow-buntings, &c., were also seen perching.

"It is, we think, undoubtedly forced upon them by the great flooding of the country, and what was originally forced upon them has become a favourite habit."

The journal for July 7, 1875, gives an artificial table for distinguishing the downs of ten species of ducks, and that is the kind of minute detail more of which we would gladly have welcomed. It is also to the point to be told of the curious antics of the Arctic (Richardson's) skuas:—

"The birds often alighted within fifteen yards of me, raised the wings over the back—when they did this the white or dusky quills showed like a patch upon the raised wings—shammed lameness and sickness, and stood reeling from side to side as if mortally wounded. If I followed them, they continued to try and lead me off; but if I again approached the nest, they flew boldly towards me, and stooped repeatedly."

There are some vivid pictures of the tundra and its birds, there is an interesting account of the Samoyèdes, and there are some instructive notes on the habits both of birds and men, for all of which one is grateful, wishing only that there had been more of this wheat and less of the journalistic chaff.

PRACTICAL SEA-FISHING.

Practical Sea-Fishing. A Handbook for Sea Anglers. By P. L. Haslope. Pp. 274; illustrated. (London: Upcott Gill, 1905.) Price 3s. 6d.

SEA fishing is not a new form of sport, nor is it a subject which has been neglected by authors. We have several excellent works on it, such as "Sea Fishing" by "John Bickerdyke" in the Badminton Library series, and "Sea Fishing on the English Coasts" by Aflalo, so that a new book requires some justification for its production.

The work under review is perhaps worthy of a place in the sea fisherman's library, but it is, in our opinion, in no way fitter to occupy that position than either of the books already mentioned. It is obviously written by a practical sea-fisherman who has tested most, if not all, of the methods of rod and line fishing which he recommends; but it is as obviously written by a man whose experience has been mostly confined to the south coast, as south coast methods are much more often referred to than those of other parts of the country.

The author does not, however, appear to be so conversant with some of the methods of net-fishing which he discusses as he is with those of rod and line fishing. For instance, he considers the otter-trawl "a much more manageable net" for the amateur than the beam-trawl, a point we think open to doubt. It is true that the otter-trawl is more easily stowed away on board, but we think that its advantage over the beam-trawl for the amateur ends there, especially if the vessel is not a steamer. The difficulty of getting the otter-trawl to spread out and of getting it to fish properly is only known to those who have tried, and we should certainly recommend the amateur to use a beam-trawl, which, it is true, may capsize when being lowered, but otherwise will always fish when down.

When Mr. Haslope touches upon natural history or the habits of sea-fish he is clearly not so much at home as when he is discussing methods of capture. For instance, he refers to the angel fish, *Rhina squatina*, as a species of ray. He mixes up *Atherina presbyter*, the sand-smelt, and *Osmerus eperlanus*, the true smelt, and says "the Atherine, or sand-smelt, is the variety generally met with" (p. 100). In speaking of the sand-eel, he says:—"Any not required for bait should be fried and eaten, as they form a delicious article of food when in roe, but are not so good in winter" (p. 52). In our experience the sand-eel breeds in the winter; but perhaps Mr. Haslope means that after they have spawned they are not so good. He says of the grey mullet that "they feed chiefly on some kinds of sea-weed and decaying vegetable matter" (p. 95). It is true that algæ are occasionally, and perhaps often, found in the stomachs of grey mullet, but we should put down the staple food of the species as being animal. If we recollect rightly, in the aquarium at the Plymouth laboratory these fish are fed chiefly upon nereid worms. Day says that they are very destructive to molluscs and minute Crustacea, and that they also eat larvæ and ova ("Brit. Fishes," I., p. 234).

The English of the book is not all that can be desired, and badly arranged sentences are far too common. For instance, "In form this fish is very slender and its shape has some resemblance to that of a large sand-eel, which enables it to pursue its prey with great rapidity" (p. 50). "Great quantities of these crabs are taken in trammels and the shell on the back is so sharp and rough that it quickly cuts the twine, sometimes damaging the nets almost beyond repair. They are generally thrown away or used as manure for the gardens" (p. 60).

The directions as to skinning a ray are exceedingly involved:—

"To skin a Ray, remove a small portion with a sharp knife and grasp it with an old cloth in the left hand. This affords a firm hold, and by its means the whole skin can be readily stripped off. Meanwhile hold the fish firmly with the right hand, making with a knife a hole, or an incision, to enable the fingers to obtain a firm grip. Leave it upon the board in the open air with the flesh side upwards, and when dry it will have attained the consistency of horn, &c. . . ." (p. 68).

We prefer the old books on the subject of sea fishing, although, as we have said, the practical advice in the present work is thoroughly sound.

FRANK BALFOUR BROWNE.

MATTER AND FORCE.

(1) *Molecular Forces and Newtonian Laws.* By Alex. Clark. Pp. 237; illustrated. (Glasgow: W. and R. Holmes, 1905.) Price 3s. 6d. net.

(2) *Explication méchanique de la Matière, de l'Électricité et du Magnétisme.* By M. Despaux. Pp. 210. (Paris: Félix Alcan, 1905.)

(1) "BY deductions from the Newtonian Laws of Force and Motion the Author accounts for all the facts of Magnetism, Electricity and Chemical Affinity and proves their identity with gravitation" (extract from circular of publisher). We ourselves do not think that the author is successful in his attempt;

but this opinion of ours may possibly arise from the difficulty we have felt in fathoming his arguments. There is an originality of statement about them which often makes it impossible to decide hurriedly as to whether they are right or wrong. For example:—

"Electricity is not to be confounded with the electric spark—they are the direct opposites of each other. Electricity is a force of attraction which brings particles of matter into contact; the electric spark is the kinetic energy produced by the action of the electric force through the available distance, and has a dispellant effect upon the particles. By the conservation of energy the electric force ceases to act when the spark is produced. The potential is then converted into kinetic energy. This affords a conclusive reply to the theory, adopted by some eminent authorities, that electricity and light are identical. Light is a form of heat and has always a dispellant effect upon the particles of matter. It is therefore the direct opposite of electricity, which is a force of attraction."

This is certainly not all wrong. The question is how much of it is right? To those readers who are attracted by the above extract we recommend the two hundred and thirty-seven pages of this volume.

(2) Just as in the work reviewed above the dependence of forces upon position is made the universal law, so here the essential identity of all forces is sought for in a kinetic view of matter.

All phenomena of attraction are explained, and can be reproduced by the simple rotation of a screw or turbine in water and in air. The turbine is presented as the universal motor which gives rise to molecular attractive forces and the phenomena which accompany them. The author claims to assume nothing besides the propulsive motions produced by rotations of molecular turbines, and congratulates himself on the rare good fortune that everyone can understand the effects of such rotation.

A number of experiments with ventilating fans are described; the author then wanders off into a comparison of a magnet with a living being, and a consideration of the position of man in the universe.

It is a commonplace to suppose that scepticism is the beginning of belief; the author's creed is accompanied by the usual doubt as to the validity of many of the conclusions of modern science. The value of his criticisms can be measured by his objections to the recognition of the essential identity of light and Hertzian waves. He disposes of the argument which rests on the identity of velocity of the two phenomena by saying that all waves produced in the ether, of whatever nature they may be, must, in fact, have the same velocity, since the velocity of a wave depends, not on its form, but only on the elasticity and density of the medium of transmission, which in this case is the ether.

We cannot look upon this book as a serious contribution to scientific literature, but we readily admit that there are analogies between the effects of the motions which the author describes and other physical phenomena; and if these were systematically described a very interesting volume could be made. But there is so much here that is merely fanciful that we must advise anyone who reads it to read it with caution.

OUR BOOK SHELF.

A Descriptive Handbook of Architecture. By Martin A. Buckmaster. Pp. xvi+188. (London: George Routledge and Sons, Ltd., n.d.) Price 3s. 6d. net.

This is a little book which is intended to help those to whom architecture is a subject of ever-increasing interest. The author refers to a subject which Mr. Banister Fletcher has already brought forward prominently in the preface to "The History of Architecture" and in a paper read before the University Extension Guild, namely, the inclusion of the study of historical architecture in a liberal education. It certainly seems that, owing to the ease of travel, the use of photography and other causes, a knowledge of the elementary principles and forms of the various types of architecture might well be expounded to the senior forms of educational institutions, and this way of interesting the rising generation in matters which appertain to everyday life and observation would tend largely to increase interest in matters artistic and practical.

Concerning the book under notice, much cannot be expected for the low price at which it is published, and it would probably have been better had the author dealt with one period of architecture, and have done that thoroughly, rather than have taken up so large a field. It has resulted in an essay which is "scrappy," and from which we are afraid the attentive student will gather very little of much use to him.

One or two points call for revision. Why is "mediæval" architecture made to *end* at 1090 when most people hold that it *commences* about that time?

Plate iii*a*. is merely an enlargement of part of plate xviii., and might be omitted. Some of the illustrations are very poor; that on p. 20 would lead the student to believe that the Temple of Theseus and the Parthenon had suffered from an earthquake since we saw them last spring!

The ground range of the columns to the Colosseum is not Doric, dentils are wrongly spelt on pp. 25 and 27, and the Temple of Zeus, Athens, is given another name on p. 28. The giving of exact dates for each period, and the printing at the top of each page, are sure to mislead the student; for no style can be truly confined within a period of such exactitude as, say, 1377–1547, and the student should be warned against such an attempt.

The line illustrations are of an amateurish description, and plates viii. and xi. should be re-drawn.

Plate xliv. seems to be a copy of a plate in a well known history, though this is not acknowledged. The division of early Christian architecture into Roman and Byzantine is likely to confuse the student, as Roman is always considered historically as pagan architecture.

Proceedings of the London Mathematical Society. Vol. ii. Pp. xx+490. (London: Francis Hodgson, 1905.)

The present volume of *Proceedings*, though the size of the page has been changed, and larger type is used, contains about the same amount of subject-matter as its predecessors. It affords evidence that the publication of researches in higher mathematics still receives the same care and attention which it has for many years past obtained at the hands of the small body of workers who mostly travel up on Thursdays by the 2.15 train from Cambridge to attend the meetings in Albemarle Street with their friends. It contains interesting obituary notices of Mr. Ronald Hudson and Dr. Pirie. Among the contributors we

note the well known names of Dixon, Glaisher, Hilton, Hobson, Jackson, Lamb, Love, MacMahon, Morley, Volterra, Rayleigh, Young, and many other mathematicians. An attempt to classify the papers by subject-matter would be difficult, but a general survey of the ground covered suggests that a not inconsiderable proportion, possibly as much as a half, of the work done comes under the heading of "analysis."

But while the reputation of English mathematical research is thus being maintained, it does seem a pity that there is no society which has undertaken the task of popularising the higher study of mathematics in our country in the way that has been undoubtedly done on the other side of the water by the American Mathematical Society, with its *Bulletin* containing full reports of meetings of mathematical societies, educational appointments, and courses of university lectures. The Mathematical Association has done much to render elementary mathematics more practical and interesting. The duty of impressing on the proper authorities the need of providing more fully for instruction in *advanced* mathematics in our *technical* colleges has not as yet been undertaken by any body of mathematicians, yet the matter is an urgent one as affecting national progress in the face of foreign competition. In connection with most of the papers before us, an enormous amount of work is generally done in refereeing previous to publication. Is it not possible that the energy thus expended might with advantage be diverted into some such directions as those above indicated?

Catalogue of the Collection of Birds' Eggs in the British Museum (Natural History). Vol. iv., Carinatæ (Passeriformes, continued). By E. W. Oates, assisted by Captain S. G. Reid. Pp. xviii + 350; 14 plates. (London, 1905.)

IN this volume the authors record the eggs of seventeen families of passerine birds contained in the national collection, thus carrying down the work to the family Certhiidæ (creepers), so that another volume ought, apparently, to bring their task to a conclusion. The total number of species catalogued in the volume before us is 620, which are represented by no less than 14,917 eggs—figures which give some idea of the heavy work the authors had to undertake. Fortunately, the Radcliffe Saunders and the C. B. Rickett collections were received in time to allow their quota to be added to the MS.

We had hoped that as the work progressed the authors would have seen their way to modify the style of the paragraphs recording the distinctive features of the various species catalogued. We regret to see that this is not so, and with the same dreary and wearisome iteration we find entry after entry commencing with the statement that the eggs of such-and-such a bird are of such-and-such form and colour. As a matter of fact, if the English names of the various species had been printed in the same lines as their scientific titles there would have been no occasion to mention the word "eggs" at all in the descriptive paragraphs, which should commence merely with a reference to their form and colouring. By this means not only would much valuable space have been saved (as might also be done in the mode of making the entries themselves), but the reader would have been spared that everlasting and utterly superfluous repetition which is so irritating to any person of literary tastes. We may also direct attention to the crude and schoolboy-like style of composition characterising almost the whole of the paragraphs in question. Reference may likewise be made to some imperfection in the method of recording localities. If, for instance, it is necessary to tell us on p. 16 that certain places are in the Nilgiri Hills, it was surely incumbent on the authors to give the same piece of information on p. 8, while to wait until p. 264 before stating that the Nilgiri Hills themselves are in southern India is a very remarkable proceeding. We are also surprised to learn (p. 162) that Dharmsala is in Kashmir.

The great feature of the volume is the beauty of the fourteen coloured plates of eggs, each containing a large number of figures, all of which have been drawn and coloured by Mr. H. Grönvold. These serve to illustrate very graphically the degree of constancy or variation which obtains in the egg-characters of the different family groups, and in addition to this show some very remarkable examples of individual variation or "sports."

Leather for Libraries. By E. Wyndham Hulme, J. Gordon Parker, A. Seymour-Jones, Cyril Davenport, and F. J. Williamson. Pp. 57. (London: Published for the Sound Leather Committee of the Library Association by the Library Supply Co., 1905.) Price 1s. 6d.

THIS interesting book, which may have a considerable influence on the improvement of book-binding, consists of five chapters, one by each of the authors whose names are on the title-page, three of whom are members of the Sound Leather Committee of the Library Association, and may therefore be considered as authorities on the subjects of which they write.

When light leather is tanned by bark and many other vegetable tanning substances the skin becomes coloured, and this colour cannot be removed without deterioration of the leather. In 1565 sumach tanning was introduced into England; this process leaves the skin white and in a suitable condition to receive the necessary dye. Experiments conducted by the Society of Arts Committee have shown that sumach tanning is the most suitable for binding leathers. Unfortunately this process is a slow one, and other tanning materials which act more rapidly have been employed; some of these, however, have a deleterious action on the leather, causing it to decay rapidly. Another cause of the short life of some modern leathers is the use of sulphuric acid at one stage of the process. This acid combines with the fibre and cannot be removed; it has a corrosive action on the organic matter, which action has often been attributed to the presence of sulphur in the coal gas used for lighting. In some libraries, however, which are not lighted by gas, the bindings have been found to perish in the course of a few years, and the presence of sulphuric acid in these leathers indicates the cause. Sulphuric acid is also used in connection with the aniline dyes frequently employed for colouring. Another source of weakness is the splitting of the leather in order to obtain smooth surfaces; this process necessarily cuts the network of fibres, and thus diminishes the strength of the material. The tanner should have regard to the sources of the skins, and if they are imported it is advisable to consider the treatment that they have undergone before coming into his hands.

It is impossible to do justice to this book in a short notice, but the attention that has recently been directed to the subject seems already to have borne fruit, for in the advertisements of leather-sellers and bookbinders at the end of the book there are such notices as "dressed according to the recommendations of the Society of Arts Report" and "guaranteed free from mineral acids." H. M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

British Mosses.

In the review of Dr. Braithwaite's "British Mosses" which appeared in your number of August 31 (vol. lxxii. p. 425), I attributed the finding of *Catharinea tenella* to Lord Justice Stirling, and I did so on the authority of a passage relative to the plant in Dr. Braithwaite's supplement. The Lord Justice is, I find, desirous that it should be known that the entire merit of the discovery is due to Mr. E. S. Salmon. "I had the good fortune," says the learned judge, "to be his companion when the little plants were gathered, but his eye detected them in the field, and by his acuteness the true name of them was discovered." I am glad to second the Lord Justice in his desire that no mistake should be made in this matter, and I beg your courtesy to insert this short note. E. F.

November 8.

Border occasionally seen between Light and Dark Regions on Photographic Prints.

Since my recent brief note on a photographic appearance, Mr. Burke has informed me that the subject attracted the attention of Sir George Stokes, and was thought worthy of a communication from him to the Royal Society in May, 1882 (*Proc. Roy. Soc.*, vol. xxxiv. p. 63).

Had I been aware of that I should, of course, have referred to it. It seems to me now that there may be more than one explanation of such an appearance.

OLIVER LODGE.

Halation.

When a photograph is taken of a dark object with a bright object or the sky some distance behind it, blurring occurs where the images of the objects meet.

That part of the bright object from which only a part of the lens is visible (the rest of the lens being cut off by the dark object) forms an image of varying brightness in the shape of a band which covers the edge between the images of the dark and light objects. If the bright object be at an infinite distance from the lens, the breadth of the band will bear approximately the same ratio to the diameter of the lens as that which the focal length of the lens bears to the distance of the lens from the near object.

It seems probable that many cases of halation are due to this cause. J. A. COBB.

108 Church Road, Richmond, Surrey, November 13.

The Engineer's Unit of Force.

I am much indebted to "The Reviewer" for his courteous answer to my letter on the subject of the engineer's unit of force in your issue of November 2.

I readily admit that the engineer's unit of force may be so defined as to make it a constant quantity independent of locality; but does the engineer *in actual work-a-day practice* make use of this invariable unit? In problems involving the derived unit of work, does he not, as a matter of fact, estimate the work done or the potential energy, as the case may be, by multiplying together the distance factor and the weight (*i.e.* the force) factor *without making any allowance for the variation of the latter with latitude?*

The question at issue, it seems to me, narrows itself down to this: is the title "engineer's unit of force" to be applied to the variable unit in actual use by the engineer, or is it to be restricted to the absolute gravitational unit, which may be defined, but which in nine cases out of ten is not actually applied in engineering practice? D. J. CARNEGIE.

Newton Abbot, November 6.

It is quite true that in engineering practice a correction for latitude is seldom made in regard to the gravitational energy of a raised weight, the reason being that other and very much larger sources of error are usually present. But under sufficiently refined conditions this small correction is actually made. A Bourdon pressure gauge registers pounds per square inch in absolute measure the same everywhere. If Mr. Carnegie considers the pound force to vary with locality, what is his value, in foot pounds, for Joule's equivalent at the centre of the earth?

But surely even Mr. Carnegie himself must use the foot-pound unit, and hence the pound-force unit, in an absolute sense, when applied to such quantities as the kinetic energy of a rotating fly-wheel, the strain energy of a stretched spring, the work done on the piston of a steam or gas engine, the energy of motion or of position of a planetary body, &c.

The present case is an illustration of the apparent inability of academic writers to understand the engineer's position in this matter, and of the confusion which inevitably arises from the combination of two closely related systems of units. In any dynamical system the magnitude of unit mass is quite arbitrary, and the pound mass possesses no intrinsic merits over any other unit. Indeed, the choice of the pound unit has proved to be a most unfortunate one, for the conception of inertia or mass, coming as it does after that of force, finds the pound force already established and ingrained in the mind, forming an effective barrier against the practical adoption of the derived poundal, and being a fruitful source of error on account of the new and old meanings attached to the word pound. People do not, and never will, think in poundals, and so custom has compelled its advocates to incorporate into their system the pound force and the foot-pound unit of work, a tacit admission of its practical failure. Engineers contend that this duplex system with its overlapping terms is harmful and quite unnecessary. They advocate a single system which, so far as possible, shall adopt units in common use. The system used by them fulfils all requirements. It is an absolute dynamical system. Its terminology is not divorced from common thought and speech. It gives an exact and absolute meaning to the pound force and consequently to the foot-pound unit of work, and its unit of inertia has a distinct name of its own, never used in the sense of force, thus avoiding the conflicting nomenclature of the present mixed system. The engineer's and the C.G.S. systems are sufficient for all purposes, and it would be a great gain if the academic British system could be abandoned. THE REVIEWER.

THE EXPLORATION OF THE ATMOSPHERE OVER THE TROPICAL OCEANS.

THE study of the trade-wind region by the use of kites was first proposed by Mr. A. L. Rotch at the meeting of the British Association at Glasgow in 1901, after he and his assistant, Mr. Sweetland, had obtained a series of observations with them during a voyage across the North Atlantic. This method of investigation was later adopted by other meteorologists, notably by the French Scandinavian expedition to explore the atmosphere, which, under the direction of M. L. Teisserenc de Bort, flew kites in 1902 on the Baltic, and last year by Prof. Hergesell, who communicated to the Aëronautical Conference at St. Petersburg the interesting results of a cruise on the yacht of H.S.H. the Prince of Monaco in the vicinity of the Azores and Canaries. During this voyage fourteen kite-flights, some of which reached a great height, were made, and in a communication to the French Academy of Sciences on January 30 Prof. Hergesell said:—"Un courant de S.W., qui correspondrait au contre-alizé théorique, n'a jamais été trouvé par les cerfs-volants bien qu'ils aient plusieurs fois dépassé la hauteur du Pic de Ténériffe. Plusieurs constatations m'amènent à penser que les vents de S.W. observés au Pic par plusieurs observateurs sont d'origine locale et dûs à l'influence de l'île."

Thus Prof Hergesell believes that the north-west wind which was found overlying the thin north-east stratum is a return current, or anti-trade, for he says:—"Der Luftersatz im Anti-passat erfolgte deshalb vorwiegend in der von uns durchforschten Gegend aus nordwestlichen Richtungen" (Aëronautical Conference, St. Petersburg, 1904, supplement vii., p. 91).

It appeared to the writers that these conclusions, which tended to invalidate the existence of the upper anti-trade, required further investigations, and by mutual consent we decided to have these carried on by two of our assistants, Mr. Clayton, meteorologist at Blue Hill, and M. Maurice, assistant at Trappes, aboard the *Otaria*, a large fish-carrying steamer, equipped with the electric kite-reel which M. Teisserenc de Bort had used for kite-flying at sea.

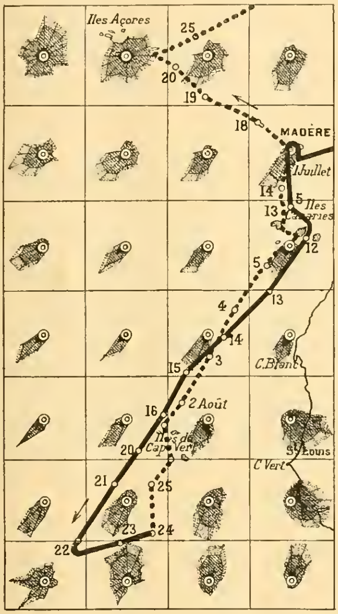


FIG. 1.—The route of the *Otaria*. The diagrams in centre of squares show the mean direction of surface winds in summer, by Captain L. Brault.

A study of the high barometric pressures at the Observatory of Trappes (see *Comptes rendus*, 1899) led to the conclusion that there exists, generally, at a moderate altitude, a zone of light winds which ordinarily the kites cannot penetrate. While it is true that at sea an artificial breeze may be created by steaming in a direction contrary to that of the wind, this method is inefficient in the trades, because, if, as is usually assumed, there is almost complete reversal in the directions of the upper and lower winds, the top kite arrives in the south-west current while the others are still in the north-east wind, and consequently the flight is stopped just where the change of regime commences. Therefore it is necessary to employ a single kite and a boat which is sufficiently fast to lift the kite regardless of the direction of the wind, but as these conditions cannot always be realised, in order to attain great heights on this expedition the paper pilot-balloons already tried at Trappes were used. Since these balloons were only intended to show the direction of the wind, they did not usually carry instruments, and their drift and height were determined by simultaneous angular measurements at the ends of a base-line on the shore, with the exception of one balloon which was observed from the boat. These soundings of the atmosphere, executed at various places, notably at Madeira, Teneriffe and Cape Verde Islands, and also over the open sea, gave the following results, to which are added observations of winds on two tropical mountains and during one of the kite-flights.

In the table on p. 56 the first column indicates the upper limit of the north-east trade, and the second column the limit of the associated north-west wind, these heights being expressed in metres. In the third column the figures in parenthesis show the maximum

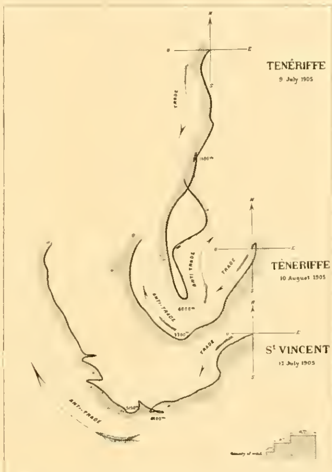


FIG. 2.—Direction of wind at great height, shown by the tracks of balloons.

heights at which the balloons were observed moving in the anti-trade, from south-east, south, or southwest.

There follow observations at different heights on the peaks of Teneriffe and Fogo, the figures after the direction of the wind being its velocity in metres per second. There is also noted the drift of the clouds passing above the peaks. The diagrams (Fig. 2) represent the direction and speed of the balloons which were sent up from Teneriffe on July 9 and from St. Vincent on July 17.

The tables and figures show that the winds blowing toward the equator have a direction varying between N.E. and N.W., these last being usually above the N.E. stratum, the thickness of this layer of the *trades* in the vicinity of Teneriffe being about 3000 metres or 5000 metres. Above it blow S.E., S., and S.W. currents which form the *anti-trades*, its thickness being probably very great, though its density is small. Thus, as was deduced from the observations of clouds and volcanic dust, the east wind in the vicinity of the thermal equator extends very high. At the Cape Verde Islands the south-east

wind was observed by a balloon up to a height of 11 kilometres.

As is seen, these results confirm the accepted theory of the *trades* and upper *anti-trade* in those parts of the Atlantic explored by the *Otaria* (see chart of route, Fig. 1), and prove that, contrary to the opinion of Prof. Hergesell, there exists a return current, or anti-trade, with a well defined southerly component.

We hope to give in a subsequent article the conclusions regarding temperature and humidity derived from the kite-flights made on the *Otaria*.

Winds above the Atlantic, between latitudes 11° and 37° N., longitudes 15° and 26° W., observed during the cruise of the S.Y. "Otaria" in 1905.

Punta Delgada—
August 22 ... ... 800 N.E. ... (4200) N.E.

Madeira—
Aug. 16, 1800 W.N.W.; 11,500 N.W. & S.W.[1]; (11,600) W.S.W.
,, 17, 2900 N.E.; 4,200 N.W. & N.E.; (12,500) W.S.W.

	Trade		Anti-Trade
	N.E.	N.W.	S.E., S., S.W.
Teneriffe—	metres	metres	metres
July 7	400	3500	(7500)
,, 9	300	4000	(5760)
,, 10	3000	5200	(11,000)
Aug. 10	3100	none	(5900)
,, 11	2300	,,	(3900)
At sea near Palma—			
Aug. 13	2600	3400	(6500)
St. Vincent—			
July 17	3200	3700	(11,000)
,, 18	1300	none	(2360)
,, 29	650	1900	(11,000)
11° N., 26° W. (Kites)—			
July 24	2500	(3000) E. ? strong	

Peak of Teneriffe—
Aug. 8 ... Base, E. 2; 500, E. 0; 1000, calm; 1500, N. 2; 2000, N. 2; 2500, N.N.W. 4; 3000, wind variable; 3500, S.; 4000?, Al.-Cu. clouds moving from S.

Peak of Fogo—
July 27-28. Base, wind variable; 500, E. 1; 1000, N.E. 13; 1500, N. 9; 2000, N. 7; 2500, E.N.E. 7; 3500?, Al.-Cu. from E.

A. L. ROTCH.
L. TEISSERENC DE BORT.

[1] Mixed stratum of N.W. and S.W. winds.

SOUTH AFRICAN ZOOLOGY AND PALÆONTOLOGY.

THE recent visit of the British Association to South Africa affords a favourable opportunity of directing attention to the zoological and palæontological work now being carried on by the museum at Cape Town under the able direction of Mr. W. L. Sclater, more especially as exemplified in that excellent serial publication entitled the "Annals of the South African Museum." Of this serial, which commenced in 1898, three volumes have been completed, and some seven parts of the fourth volume published up to the end of July of the current year, making a total of at least twenty-nine separate parts, each devoted to a special subject.

From the time that he took charge of the museum, Mr. Sclater appears, indeed, to have determined to devote all his energies towards increasing our knowledge of the fauna of South Africa. His mode of accomplishing this praiseworthy object seems to be threefold. In the first place, efforts have been made to increase the collections in the museum at Cape Town—both as regards the exhibition and the study series—by all possible means, and thus to afford as ample a basis as possible for the work of specialists, and at the same time to awaken increased interest on the part of the public in the museum itself. The second part of the programme consists in the publication of monographs of such portions of the South African fauna as are ripe for this mode of treatment. As examples of work of this nature may be cited the handsome volumes on the mammals and birds of the country, published some few years since, and duly noticed in our columns as they appeared.

Work of the above nature consists to a great extent in collating, revising, and adding to the labours of earlier naturalists; but, in addition to this, much of an altogether newer type has to be made known to the scientific world in such a rich, and in many respects little-worked, field as that presented by South Africa. And it is to work of this latter description that the "Annals of the South African Museum" are mainly devoted. Fortunately, the officers of the Geological Survey of Cape Colony have availed themselves of this excellent means of publishing the results of researches into the palæontology (both zoological and botanical) of this part of South Africa, and the "Annals" accordingly promise to afford within a few years a perfect mine of information with regard to South African zoology and palæontology.

Although the description of more or less entirely new work occupies much of the "Annals," monographs of groups, or revised lists of groups already monographed, come within its purview. For example, the moths of South Africa, which for many reasons could not probably be monographed in separate volumes, are in course of description by Sir George Hampson, of the British Museum, and two parts of his monograph have already appeared. Again, Mr. Sclater has taken advantage of this mode of publication to issue a revised list of South African birds, containing such additions and corrections as have been made since the issue of the volumes on this group in the series devoted to separate monographs of the South African fauna.

To mention by name all the papers included in the volumes of the "Annals" already published would be altogether beyond the limits of available space, and it must suffice, therefore, to refer to a few others. In the palæontological series, the first part of the important account of the fossil floras of the Cape, by Mr. A. C. Seward, of Cambridge, has already received special notice in NATURE. The molluscs and brachiopods of the Bokkeveld beds respectively form the subjects of two papers by Mr. F. R. C. Reed; and these and the trilobites, which are described in another paper by Mr. P. Lake, serve to demonstrate the Devonian age of the beds in question, and thus point to a definite period when at least a part of what is now South Africa was beneath the sea. The affinity of the trilobites to South American types is noteworthy. A fifth paper, by Mr. F. Chapman, is devoted to the foraminifera and ostracods from shallow water deposits of Lower Cretaceous age in East Pondoland. In the zoological series, in addition to those already mentioned, six papers by Mr. Peringuey, assistant director of the museum, form an important contribution to our knowledge of South African beetles; while in another part the Rev. O. Pickard-Cambridge has described a number of new spiders, including three new generic types; and there are many other papers of equal importance and interest.

In conclusion, we congratulate all those who have done so much good which this serial has been the means of communicating to the world, and trust that financial considerations will not be allowed to interfere with the continuation of such a valuable and important publication.

R. L.

SCIENTIFIC RESEARCH IN THE PHILIPPINE ISLANDS.

THE valuable scientific work which is being carried out in the Government laboratories, Manila, has from time to time been noticed in these columns, and the record for the third year is stimulating reading and reflects the greatest credit on those by whom it has been done, and on the enlightened Government which has rendered it possible.

Dr. Paul Freer details in his report [1] the routine work of the laboratories and the nature of the investigations which have been carried out. In the chemical laboratory the analysis of foods and drugs, the standardisation of weights and measures, and the examination of the natural products of the country, vegetable and mineral, are some of the subjects dealt with. In the biological laboratory clinical investigations and pathological examinations are carried out, while valuable work is being done by the attached botanist and entomologist. The serum laboratory has been occupied in the preparation of an anti-rinderpest serum, which greatly mitigates the ravages of the disease, and of vaccine virus, while investigations have been made on plague and on the preparation of a cholera vaccine.

FIG. 1.—The New Laboratory Buildings, Manila.

While so much good work has been done in the past, we may expect considerable development in the future, as Dr. Freer is able to chronicle [2] the erection of new laboratories, the completeness of the arrangement and equipment of which will materially facilitate scientific investigation. The accompanying illustration shows the front elevation of the new buildings, which have the form of the letter "T," consist of two stories, and are erected on a site 23 acres in extent, on which an up-to-date hospital is also to be established, laboratory and clinical work thus being brought into proper contiguity.

The eastern half of the structure is devoted to biological work, and comprises rooms for the preparation of culture media, bacteriological and pathological laboratories and pathological museum, botanical room and herbarium, entomological room, and general biological laboratory, while the western half is devoted to chemical and physical work, and comprises laboratories for organic and physiological chemistry, a commercial laboratory with stills, baths, and machinery for carrying on commercial processes on a laboratory scale, rooms for photometry, adjustment of weights and measures, assaying and mineral analysis, organic combustions, agricultural work, food analysis, &c., together with balance rooms, laboratory for physical chemistry and physics, and a room for spectroscopes and instruments of precision. All the work tables are supplied with gas, electricity for light and power, steam, vacuum, and compressed air. There are in addition boiler and engine house, cold storage, cremating furnace, photographic laboratory, incubating chambers, animal house, serum laboratory, &c.; nothing, in fact, seems to have been forgotten.

Lastly, there is an excellent library of some 17,000 volumes, and the list of current periodicals on all subjects is very complete. Reference is made to the difficulties which have had to be overcome in preserving the books from the ravages of damp and of insects in this tropical climate. The legs of the book presses (which are of metal) stand in tins of petroleum, which effectually prevents the access of insects when the books are on the shelves, and varnishing the books with the following varnish has been found to be of service:—pure white shellac 50 grams, resin 20 grams, bichloride of mercury 1 gram, alcohol 1000 c.c. The constituents are mixed, and after twenty-four hours are filtered. The report and bulletin are illustrated with a number of plates, plans, and charts.

R. T. HEWLETT.

[1] Third Annual Report of the Superintendent of the Bureau of Government Laboratories, Manila, 1905.

[2] Bureau of Government Laboratories, *Bull.* No. 22, 1905. (1) Description of New Buildings, by Paul C. Freer, M.D., Ph.D. (2) A Catalogue of the Library, by Mary Polk, Librarian.

DR. WALTER F. WISLICENUS.

ASTRONOMERS have universally acknowledged the value, the accuracy, and the completeness of the "Astronomische Jahresbericht," which, appearing annually for the last six years, has presented an admirable history of the progress of the science. The systematic arrangement and organisation of its contents have made this compilation a necessity in every observatory, and the announcement of the death of its originator, Dr. Walter Wislicenus, at the early age of forty-six will have been received with profound regret by all who know this work. The deceased astronomer, who occupied the position of Professor extraordinary at Strassburg, began his career at Dresden, but the fame of Winnecke as a teacher, coupled with the advantages afforded by the efficient equipment of the new observatory at Strassburg, induced Dr. Wislicenus to migrate to that university, with which he remained connected until his early death.

Although Dr. Wislicenus will be best remembered for his literary work, and particularly for that already mentioned, his services to practical astronomy were by no means few or unimportant. In 1882, while still a student at Strassburg, he took part in the German expedition to Bahia Blanca to observe the transit of Venus, and for this task he was eminently fitted by the study he had made of the use of the heliometer. He not only continued to observe with this instrument after his return to Strassburg, but added a series of meridional observations of the zone -2° to -6°, and some of the results of his work are incorporated into two papers, one on the determination of the period of rotation of Mars, and the other on the absolute personal error in meridian observations; but his most important services were rendered in the cause of astronomical literature.

Besides his articles in Valentiner's "Handwörter-

buch der Astronomie" on stellar photometry, spectroscopy, and chronology, he published a treatise on the determination of geographical positions for the use of travellers and explorers which was favourably received. His periodical compilation on the current history of astronomy has proved itself so useful and important that it is to be hoped it will be continued by some other hand. As a teacher of astronomy he is acknowledged to have been very successful. His presentation of the most recondite subjects was masterly and edifying, arresting and retaining the attention of his class.

NOTES.

THE list of honours conferred by the King on the occasion of His Majesty's birthday, November 9, includes the name of Prof. G. H. Darwin, F.R.S., who has been appointed a Knight Commander of the Order of the Bath (K.C.B.). Dr. W. Saunders, director of the experimental farms of the Canadian Department of Agriculture, and Dr. M. A. Ruffer, president of the Egyptian Sanitary Board, have been made Companions of the Order of St. Michael and St. George (C.M.G.). Sir Felix Semon has been appointed Knight Commander of the Royal Victorian Order, and the honour of knighthood has been conferred on Mr. Arthur Chance, president of the Royal College of Surgeons in Ireland, and Prof. McFadyean, principal of the Royal Veterinary College, Camden Town.

THE death of Prof. Albert von Kölliker on November 2, at eighty-eight years of age, has deprived the scientific world of one of the founders of modern systematic histology, and the eldest of the illustrious teachers and investigators in the realms of embryology and comparative anatomy. An outline of his scientific work was given in NATURE of May 5, 1898 (vol. lviii. p. 1), as a contribution to our series of Scientific Worthies; but his memoirs and other writings are so numerous that no adequate description of them can be contained within the limits of a short article. In the course of that appreciative notice, it was pointed out that von Kölliker was one of the first to realise that the complete justification of the cell-theory must be accomplished by a study of the whole history of animal tissues, from the fertilised egg onwards; and his papers on the development of Cephalopods (1844) and of Amphibia (1846–7) represent the first results of this conviction. Von Kölliker went to Würzburg in 1847 as professor of human anatomy, and almost immediately joined von Siebold in founding the *Zeitschrift für wissenschaftliche Zoologie*, to the early numbers of which he contributed a series of important papers. In the article already referred to mention was made of the considerable series of embryological and other papers, and of the masterly text-books, of which he was the author. In 1896, as a recognition of his brilliant scientific services, he was nominated a Knight of the order *pour le mérite*. He was elected a foreign member of the Royal Society in 1860, and received the Copley medal of the society.

DR. CHARLES WALDSTEIN has been created by the King of Denmark a Knight of the Royal Danish Order the Danebrog.

THE *Athenaeum* announces the death, in his seventy-fifth year, of Dr. Johann Meidinger, professor of physics at the Technical Institute in Karlsruhe, and author of a number of works dealing with the practical side of his subject.

THE superintendent of Commercial Agencies in Canada has expressed his conviction, says the *Journal of the Society of Arts*, that the establishment of a service of commercial agents to reside in British possessions for the purpose of reporting to the Commercial Intelligence Branch of the Board of Trade in London would be of immense benefit to the Empire at large. Such agents should report on all matters concerning the resources, growth, local enterprises, public contracts, openings for trade, and the investments for capital, as is done by His Majesty's consular officers and commercial *attachés* in regard to foreign countries. The superintendent adds that there is not in the whole of Canada a British official who can answer questions of the British exporter concerning Canada, while the Americans "have in the neighbourhood 190 officials."

AT a meeting of the Incorporated Society of Medical Officers of Health on November 10, Dr. Christopher Childs read a paper on a comparative study of the Lincoln, Maidstone, and Worthing epidemics of typhoid fever. After discussing the features presented by these epidemics, Dr. Childs advocated the retention of a staff of experts specially to investigate, at the earliest opportunity, similar outbreaks in the future, such a staff to consist of specially trained medical officers, bacteriologist, chemist, and sanitary inspectors, and organised by an epidemiologist of repute. Moreover, Dr. Childs advocated that in cases where water authorities refuse to listen to the repeated warnings of the medical officer of health with regard to the dangerous character of a water supply, the Local Government Board should take action to cause those authorities to take the best practicable means for removing the dangers to which attention has been directed.

AT the opening meeting of the new session of the Institution of Civil Engineers on November 9, the new president, Mr. John Gavey, C.B., gave an address in which he reviewed the progress of the telegraph and telephone industries during recent years. As illustrating the growth of telegraph and telephone accommodation provided by the Post Office, Mr. Gavey remarked that the telegraph wire mileage increased from 114,242 at March 31, 1880, to 338,120 at March 31, 1905. The telephone wire mileage rose during the same period from 40 to 253,521. There appears to be little prospect of serious competition between telephony and telegraphy after a certain critical distance has been reached. The determination of the distance over which telephonic speech is possible on various types of telephone circuit is a question of the greatest theoretical and practical interest. Telephone administrations have carefully considered what are the extreme limits of effective commercial speech, taking all the facts into consideration, and allowing a large margin of safety, and it is generally considered that from 42 to 46 miles of the English standard cable is the effective commercial limit. As to wireless telegraphy, the opinion was expressed that it is not likely to supplant, or even to compete seriously with, inland methods of communication; nor does it appear probable that it will, at least in the near future, actively compete with highly developed cable communication, although it may supplement that service. In submarine cable work the same progress may be noted as in other branches of telegraphy, the mileage of cable having increased from 87 nautical miles in 1852 to 212,894 miles in 1902, while it is still increasing. The problem of devising submarine cables for long-distance telephones has yet to be solved.

AN official guide to the Victoria Falls, compiled by Mr. F. W. Sykes, the conservator, has been published by the Argus Publishing Co., Ltd., of Bulawayo, at 1s. The guide has been compiled for the use of visitors, and is interesting throughout. On November 17, 1855, that is,

exactly fifty years ago, the falls were discovered by Livingstone. The native (Sekololo) name for the falls is "Mosi-oa-tunya," meaning "the smoke which sounds." Viewed from any of the surrounding hills, the rising columns of spray, more particularly on a dull day, bear an extraordinary resemblance to the smoke of a distant veldt fire. At sunrise, during the rainy season, a dense white column mounts upwards to a height of 1000 feet, which is visible at a distance of fifty miles from the falls. After a clear description of the places of interest in the neighbourhood of the falls, the book provides geological notes written by Mr. G. W. Lamplugh, F.R.S., botanical notes by Mr. C. E. F. Allen, ornithological notes by Mr. W. L. Sclater, and hints and cautions to visitors.

Two letters from Captain Amundsen, of the Norwegian vessel *Gjöa,* giving the earliest results of his expedition to the north magnetic pole, are published in Tuesday's *Times* (November 14). Captain Amundsen sailed in May, 1903, for Godhavn, on Disko Island, off the coast of Greenland. In the course of his first letter, dated November 24, 1904, he remarks:—February turned out the coldest month, with an average temperature of $-40°\cdot5$ C. Commenced on March 1, 1904, putting down the stores for the coming spring voyage to the vicinity of the pole. Observed during this tour—in the interior of the country—our lowest temperature, $-61°\cdot7$ C. Came back at the end of May. The summer I have spent in magnetic observations around the station. Wiik has put up the variation instruments—October, 1903—and has attended to them the whole time. Ristvedt is the meteorologist. Lieut. Hansen has to take care of the astronomical observations. Lund and Hansen have their hands full on board. The variation instruments will be kept in function until June 1, 1905. Besides the variation instruments, which have been in continual function, we also have made daily absolute observations. Along with the meteorological observations, we have also made observations of the aurora borealis. Besides we have ample collections of ornithological, ethnographical, and botanical matter, and some fossils. It is my intention to make my way out of the ice and go direct to San Francisco in the autumn of 1905. I will not omit to mention that the variation on the spot varies between N. 10° W. and N. 10° E. We have even found greater deviations. Most frequently it is about 5° W. The inclination is about 89° 20′. Captain Amundsen's second letter is dated May 22, 1905. In it he remarks:—This winter has not by far been so hard as the former. The sea-ice, which last year about this time measured about 380 cm., now is no more than about 170 cm. The lowest temperature we had in February, $-45°$. I commenced in February to circle the magnetic station, and have just finished this task. The magnetic variation house has been in uninterrupted activity. Absolute magnetic observations have been made daily, and at all temperatures. The meteorological registering instruments have been in function all the time. The zoological and ethnographical collections are constantly increasing. The magnetic variation house will be pulled down in the beginning of June, after nineteen months of uninterrupted activity.

In an article in the current number of the *Fortnightly Review* the Marchese Raffaele Cappelli sketches the growth of the ideas which led to the recent international conference on agriculture held, at the initiative of the King of Italy, at Rome. He enumerates also the advantages likely to accrue from the International Institute of Agriculture created on that occasion. At the close of the conference referred to, a protocol was signed by the representatives of all the Governments of the world—with the exception of some minor ones—favouring the establishment of the International Institute, and asking the respective Governments to adhere to the same. In the opinion of the writer of the article, the institute must aim at regularising, promoting, and generalising its internationalism. It must provide for the rapid and general diffusion of knowledge of technical improvements in the economics of production. The institute must further undertake the task of coordinating the efforts of many cooperatives scattered throughout the world, so that they may act in harmonious agreement. But most important of all will be the services which the international corporation will be able to render in the field of the economics of distribution. When once the institute is in full working order, it will be able to give an approximate idea of the stock in hand of each kind of produce, and so provide farmers with a trustworthy guide as to which crops they will be able to cultivate to the best advantage in a given year. The Marchese Raffaele Cappelli, in the course of his inaugural address as president of the International Congress of Agriculture held in Rome during 1903, adumbrated the present tendency towards international dealings in agriculture, and he is to be congratulated upon the successful inauguration of an institute which will realise the ends he has advocated.

We have received the second part of vol. lxi., and the first part of vol. lxii., of the *Verhandlungen* of the Natural History Society of Rhenish Prussia, Westphalia, and Osnabruck. Three papers, respectively by Dr. Krusch, G. Müller, and H. Westermann, are devoted to points connected with the coal-fields of Rhenish Westphalia and other districts coming within the purview of the society. Zoology is represented by a paper on the migrations of fresh-water planarian worms in the streams of the district, in which the author, Prof. W. Voight, distinguishes between the migrations of individuals and of species, and further subdivides the former class into accidental and periodical movements. In botany, Mr. F. Wirtgen descants on rare and disappearing plants of the Rhenish flora.

To the October number of the *Quarterly Journal of Microscopical Science* Dr. H. W. M. Tims contributes a suggestive paper on the development, structure, and morphology of the scales in certain bony fishes. Such a study, the author suggests, may not only throw light on the relationships of fishes, but it may also help to solve many problems in connection with the development of tooth-germs, for there seems little reason to doubt that scales and teeth are homologous. The question whether scales are ever replaced is raised in the course of the communication. Among the other contents of the same issue reference may be made to a paper by Mr. H. L. Kesteven on the developmental stages represented by the embryonic shell, or protoconch, of the gastropod molluscs.

In the October issue of the *Quarterly Journal of Microscopical Science* Messrs. Assheton and Stevens describe the minute structure of the placenta of an elephant belonging to Messrs. Sanger which in 1902 gave birth to a calf in the Zoological Society's Gardens. The duration of pregnancy appears to have been no less than twenty-eight months, although this is not absolutely certain. By an unfortunate error in Sir William Flower's article "Mammalia" in the ninth edition of the "Encyclopædia Britannica" (perpetuated in Flower and Lydekker's "Study of Mammals"), the proboscidean placenta is said to be non-deciduate. The deciduate character of the zonary

portion is, however, re-affirmed by the authors of the paper before us. On the other hand, the zonary placenta of the Sirenia is regarded as differentiated from the proboscidean type by being mainly, if not entirely, non-deciduate, although it is admitted that the two resemble one another in the long villi, which tend to remain in the walls of the uterus. Again, the resemblance of the proboscidean placenta to that of the Carnivora is deemed to be superficial, there being several important points of difference, the former having three areas of attachment in place of one. Another paper on development, by Dr. F. H. A. Marshall, deals with the mode of formation of the corpus luteum in various mammals.

In the *Proceedings of the Boston Society of Natural History* (vol. xxxiii., No. 7) Mr. A. H. Clarke gives a descriptive list of birds collected in the southern Lesser Antilles. Fishes collected in Tahiti form the subject of a paper by Messrs. Jordan and Snyder in the *Proceedings of the U.S. Nat. Museum* (No. 1422), a new species of Holocentrus being described and figured. In two other communications, Mr. C. H. Eigenmann discusses the phenomena of divergence and convergence in fishes (*Biol. Bulletin*, vol. viii., pp. 59 *et seq.*), and contributes a preliminary note on the fishes of Panama as considered from the standpoint of geographical distribution (*Science*, ser. ii., vol. xxii., pp. 18–20). As regards the first paper, the members of the American family Characinidæ present examples of both divergence and convergence, some forms being differentiated for carnivorous and others for herbivorous habits, while yet others approximate to fishes of quite different families. In the second paper it is concluded from the evidence of the fresh-water fishes that the Pacific slope fauna of tropical America was derived from that of the Atlantic slope subsequent to the shutting-off of a water-way between the Atlantic and Pacific Oceans.

In *Agricultural News* (September 23) reference is made to a memorandum written by Mr. M. Hesketh Bell, Officiating Governor of the Leeward Islands, on the occurrence of hurricanes in the West Indies. Mr. Bell points out that hurricanes do not occur in the West Indies so frequently as is generally believed, and that the accounts have in some instances exaggerated the amount of damage; further, he suggests that a scheme of insurance might be formulated which would offer great advantages to the landowners and at the same time prove acceptable to the underwriters.

The Bulletin of the Department of Agriculture, Jamaica, for September, contains an account of the discussion on cocoa cultivation which took place at the agricultural conference held in Trinidad, also notes on the fungoid and insect pests of cotton. The pests reported by the Hon. T. H. Sharp and Mr. S. Stricker include the cotton worm, which can be successfully treated when quite young with Paris green; cut worms, which attacked the roots, but also yielded to treatment with Paris green; and the cercospora fungus.

The report on the experimental agricultural work carried on in St. Kitts during the year 1903–4 has been published separately from the report on the botanic station. The superintendent, Mr. F. R. Shepherd, writes hopefully of the cotton industry and of the peculiar method generally adopted of growing the cotton as a catch crop on cane lands. Cotton seed was planted in May and June, and, after the first picking, the bushes were pulled up and sugar canes were planted. In the trials with varieties of sweet potatoes and yams, the very large differences between the yields of the better and poorer sorts furnish ample proof of the value of comparisons based on practical experiments to guide the cultivator in his choice of the best varieties.

Dr. E. B. Copeland has compiled a list of ferns belonging to the Polypodiaceæ recorded for the Philippine Islands, which is published in Publication No. 29 of the Bureau of Government Laboratories, Manila. The families are in accord with the "Pflanzenfamilien," but the subfamily Gymnogrammineæ is placed under the Asplenieæ. Of the sixty-two genera represented, naturally the largest is Polypodium, which is subdivided into six subgenera; a subgenus, Myrmecophila, is established for *Polypodium sinuosum* and *Polypodium lomarioides*, and this is followed by Drynariopsis, containing the species *P. heracleum* and *P. meyenianum*. Two species of the myrmecophilous genus Lecanopteris occur, and three species of Drynaria, a genus which is characterised by having pocket-leaves that collect detritus. In the same volume Dr. Copeland gives a selection of about twenty fungi for the islands, principally species of Coprinus, Phalliota, and Lepiota, which are said to be palatable and harmless.

We have received the first number of *Gas and Oil Power*, a new illustrated monthly review for factory owners and other power users. It contains an exhaustive article on the construction of internal combustion engines by Mr. R. E. Mathot, and a special table of the cost of power and light in the principal towns in England.

It has long been recognised that a wide field of profitable work has been opened for motors in connection with British railways. The earliest steam motor seen on a British railway began regular working in June, 1903, on the Fratton and Southsea line of the London and South Western Railway. It was designed by Mr. Dugald Drummond, and proved so successful that numerous other rail motor services have been introduced or sanctioned, for which an improved type of motor has been designed by Mr. Drummond. It seats eight first-class passengers and thirty-two third-class passengers. The total length of the car is 51 feet $2\frac{1}{2}$ inches, and it may be driven from either end. When empty the vehicle weighs 31 tons 11 cwt.

The annual progress report of the Geological Survey of Western Australia shows that in 1904, under the able direction of Mr. A. Gibb Maitland, much valuable work has been done in investigating the mineral resources of the colony. An examination was made of the Pilbara, Mount Morgans, Southern Cross, and Norseman goldfields. The occurrence of telluride ore, petzite, at Mulgabble, and of precious opal at Coolgardie was reported upon favourably, and the reputed tin finds at Cuballing and of petroleum on the Warren and Donnelly rivers were investigated. Analyses were made of manganotantalite from the Pilbara district, of scheelite from the Nullagine district, and of cobaltiferous asbolite, of no commercial value, from Greenbushes.

Excellent work is being done by the mines branch of the Canadian Government under the direction of Mr. E. Haanel, the latest departure being the inauguration of a series of monographs on the economic minerals of Canada. The first of the series, which has just been received, has been written by Mr. F. Cirkel, and deals with the occurrence, exploitation, and uses of mica. It forms a handsome volume of 148 pages, and is accompanied by a coloured geological map of the mica region of Ontario. It contains a synopsis of all the available practical inform-

ation on mica, and should lead to the development of the large mica tracts now known only by name, and to a search for the mineral in other parts of the Dominion. At the present time only a small proportion of the Canadian deposits are worked, many promising deposits having been abandoned on account of lack of experience on the part of those who directed the operations. In 1902 the value of the world's production of mica, in dollars, was as follows:—India, 507,770; Canada, 242,310; United States, 98,859; Brazil and other countries, 55,200; total, 904,139.

IN the *Smithsonian Miscellaneous Collections*, vol. xlix., Dr. A. G. Maddren has published a report of his expedition to Alaska last year in search of remains of the mammoth and other extinct mammals. The report contains a valuable description of the surface deposits of the country which will interest students of glacial geology, and there is an appendix of extracts from the published writings of Kotzebue, Beechey, and later travellers who have visited Alaska for a similar purpose. Dr. Maddren appears to have failed to obtain any important fossil bones, but his geological observations justify a few interesting conclusions. He thinks that the climate of the Arctic and sub-Arctic regions was never colder than it is at present. He is also convinced that there are no deposits of ice in Alaska which date back to the Pleistocene period, except the large glaciers. He has not observed any ice-beds interstratified with undoubted Pleistocene formations.

THE well preserved fossil ganoid fishes from the black Triassic shales of New Jersey, U.S.A., have long attracted attention. They are sometimes found in numbers so great as to excite public interest. The State geologist of New Jersey, in his last annual report (for 1904), has accordingly published a short account of these fossils, illustrated by photographs, and preceded by some elementary remarks on the study of fossil fishes in general. The chapter was prepared by Dr. Charles R. Eastman, and contains a useful summary of our knowledge of American Triassic fishes up to date. Notwithstanding the abundance of individuals, only six genera are represented—a curious contrast in this respect to any fish-fauna now existing. The species are also remarkably few, and some of them are difficult to distinguish on account of the crushing and distortion to which the fishes have been subjected during burial and fossilisation. Dr. Eastman does not describe any new forms.

THE Philippine Islands experienced a very destructive cyclone on September 26; the accounts that have hitherto reached us are rather meagre, and are extracted from the Manila *Cablenews* of September 28, which states that the storm was the worst that has occurred in the last twenty years. Some hundreds of houses were unroofed in Manila, where the wind is said to have reached a velocity of 103 miles an hour; at the naval station at Cavite damage was done to the extent of at least 100,000 dollars, but, so far as is known, the loss of life has not been very great. The Manila Observatory did good service in giving timely notice of the approach of the storm, notwithstanding that it was mostly dependent upon its own observations, as the telegraph lines in south-east Luzon were destroyed. The direction taken by the storm seems to have been from E.S.E. to W.N.W., and the rate of advance was about 12 miles an hour. The barometer fell from about 29·850 inches to 29·213 inches between 9h. p.m. of September 25 and 2h. p.m. of September 26; compared with the fall in our own latitudes, the amount, of course, is not excessive. The rainfall in twenty-four hours amounted to $4\frac{1}{4}$ inches.

PROF. J. HANN has made a very valuable addition to our knowledge of the meteorological conditions prevailing over the tropical regions of the earth by his publication of "Der tägliche Gang der Temperatur in der inneren Tropenzone," which has been reprinted from the seventy-eighth volume of the "Denkschriften der mathematisch-naturwissenschaftlichen Klasse der kaiserlichen Akademie der Wissenschaften" (Vienna, 1905). In his introduction he states that the mean temperatures of several stations in the tropics have been placed too high on account of inaccurate determinations of corrections which were applied to compute the true means. The object of the present investigation is therefore to determine the mean temperatures more exactly, making full use of the latest observations, and to employ a greater number of stations well distributed in longitude which were not previously available. Further, the two previous researches by Dove were published more than half a century ago, and no such complete work has since been published. In the present investigation the observations at thirty-five stations are utilised, and these are distributed over Africa, West Indies, Central and South America, south Asia and north Australia, and tropical oceans. To refer, even at the shortest length, to the method of reduction, the numerous tables, and the details given regarding each station utilised would considerably extend this note, but those interested in the investigation should make themselves acquainted with the volume itself.

A VALUABLE paper by Mr. S. R. Williams on the anatomy of *Boophilus annulatus* (Say), the tick which transmits the Texas fever of cattle, is published in the *Proceedings of the Boston Society of Natural History*, vol. xxxviii., No. 8, p. 313.

MR. WATKINS-PITCHFORD, bacteriologist and analyst to the Government of Natal, has published some observations on the germicidal action of copper salts and of bright copper. He concludes that in cupric sulphate, in the proportion of 1 part to 75,000 parts of water, we possess an agent which promises to be both efficient and safe.

Le Radium for October (2e année, No. 10) contains articles by Sir W. Ramsay, on a new element, radio-thorium; by M. Bloch, on the electric conductivity of selenium; by M. Charbonneau, on the transformation of currents of high tension into static discharges; and by M. Fraenkel, on the application of the X-rays in the study of the distribution of the blood vessels; together with the usual summary of researches connected with radio-activity. It is altogether an excellent number.

WE have received the second number of vol. i. of the Memoirs of the College of Science and Engineering, Kyoto Imperial University, containing reports on original work carried out by members of the university. The present number contains accounts of research in pure and physical chemistry, geology, engineering, and electricity.

THE *Psychological Review* (n.s., vol. xii., No. 5) contains an account, by Mabel S. Nelson, of an investigation of the difference between men and women in the recognition of colour and the perception of sound. As a result of many observations, the conclusion is formed that men are clearly superior in the recognition of blue and women possibly superior in the recognition of yellow. Both men and women hear farther with the right than with the left ear, men hearing better than women.

RECENT American mathematical journals contain some interesting papers. In the *Transactions of the American Mathematical Society* for July 10 M. Poincaré gives a

characteristic discussion of the geodesic lines on convex surfaces, with the aim of illustrating by a comparatively simple case the difficult questions of dynamic stability and instability in the problem of three bodies. Prof. E. W. Brown investigates a general method for treating transmitted motions and indirect perturbations such as arise when the action of the earth on the moon is modified by the influence of a planet on the earth's motion. In a long paper on the relation of the principles of logic to the foundations of geometry, Prof. J. Royce directs attention to a former paper by Mr. Kempe, which seems to have been largely neglected, and proceeds to develop the logical consequences of a theory suggested by, but more general than, Kempe's theory. Prof. Bromwich gives the classification of quadrics in hyperbolic and elliptic space, Prof. J. E. Wright writes on differential invariants, and Prof. Pierpont on multiple integrals. The remaining papers, by Messrs. Neikirk, Miller, Dickson, and Wedderburn, are all short, and bear upon the theories of groups and numbers.—In the July number of the *Annals of Mathematics* Dr. E. V. Huntington begins a series of articles on the continuum as a type of order, being a systematic elementary account of the modern theory, put together for the sake, not only of the mathematical student, but of non-mathematical students of scientific method; and Prof. Dickson proves a theorem in the theory of groups and applies it to the discussion of the real elements of certain classes of geometrical configurations.—The *Bulletin of the American Mathematical Society* gives in full a translation of M. Darboux's survey of the development of geometrical methods, the address delivered by him at the St. Louis International Congress of Arts and Sciences. In a short note Dr. Morehead proves that $F_n = 2^{2^n} + 1$ is not a prime when $n=7$, and states that he is in possession of a method for testing other similar cases. The only cases known to be primes are the first four, proved to be so by Fermat.

IN a paper published in the *Sitzungsberichte* of the Vienna Academy of Sciences (vol. cxiv. p. 553), F. von Lerch describes an experimental investigation of the electrochemical behaviour of thorium X, particularly as regards the manner in which it differs from the "induced activity" of thorium. When thorium X is dissolved in hydrochloric acid, and different metals are immersed in the slightly acid solution, the active substance which separates on the metal is not thorium X, but the induced activity; the same holds true of the product separated from the acid solution by electrolysis. On the other hand, from a solution of thorium X made alkaline with caustic potash or ammonia, thorium X is usually deposited either by a metal or under the influence of an electric current; but in certain cases, for example with amalgamated zinc, the induced activity is also thrown down. The production of thorium A and thorium B, and the relation existing between them, is also discussed.

IN vol. ix., p. 441, of the *Journal of Physical Chemistry* Messrs. E. S. Shepherd and G. R. Upton discuss the tensile strength of copper-tin alloys in relation to their chemical and physical structure. The test pieces made use of were heated for a prolonged period at different temperatures in order fully to attain the crystalline structure normal to those temperatures, the heating being followed by fixation of the properties by control of the rate of cooling. Among other results, it was found that prolonged annealing tends to coarsen the crystalline structure, to decrease the tensile strength, and to increase the ductility. In a second paper Mr. E. S. Shepherd gives an account of investigations of aluminium-zinc alloys, from which it is concluded that these series of alloys present no so-called definite compounds. There are, however, two series of solid solutions, that of zinc in aluminium and that of aluminium in zinc.

WE have received the annual address of the retiring president of the Society of Public Analysts, reprinted from the *Analyst* of April of this year. In the course of his address, Mr. Fairley referred particularly to the necessity that exists for a properly constituted authority to supervise the standard for drugs. In "Notes on the History of Distilled Spirits," published in the *Analyst* for September, Mr. Fairley includes an interesting collection of illustrations of ancient forms of stills used in several countries. The manufacture of whiskey was a matter of common knowledge amongst the people of Ireland when their country was invaded by the English in 1170–2, its Celtic name being "uisque beatha," meaning water of life. The distillation of brandy began to take form in France as a manufacturing industry early in the fourteenth century. Originally known as brandwine, brandewine, or brandywine, the term brandy came into use about 1657.

WE have received the first part of a "Natural History of the British Butterflies, their World-wide Variation and Geographical Distribution," by Mr. J. W. Tutt. The work is being published by Mr. Elliot Stock at 1*s*. net per part.

MR. R. W. ROBINSON has prepared a revised edition of "The Photographic Studio and what to do in it" by his father, the late Mr. H. P. Robinson (London: Iliffe and Sons, Ltd., price 2*s*. 6*d*. net). Few changes have been made, but references to some matters now out of date have been omitted. Amateur as well as professional photographers who wish to know something of the poses and practice of good portraiture will find Mr. Robinson's book a useful guide.

A SECOND edition of "Thermodynamique," by M. G. Lippmann, has been published in Paris by M. A. Hermann. The edition has been edited by MM. A. Mathias and A. Renault. The author endeavours first to elucidate the principles of thermodynamics in such a way that they may be applied intelligently. The facts upon which the principles rest are then explained. The general method of treatment adopted will enable the student to apply the principles of thermodynamics to particular cases, and thus render it unnecessary to search in a book for the right equation to use.

FIVE parts of a work on the fauna of New England, to be included in the occasional papers of the Boston Society of Natural History, have been received. The society is able to print this work by the aid of the proceeds of the Gordon Saltonstall fund. The first part is a list of the Reptilia, by Mr. Samuel Henshaw; the second of the Batrachia, by the same authority; the third is by Mr. Glover M. Allen, and deals with the Mammalia; the fourth, by Mr. Hubert L. Clark, is concerned with the Echinodermata; and the fifth is a list of the Crustacea, by Miss (or Mrs.) Mary J. Rathbun. When the series of lists is complete we hope to review them in these columns. Parts are to be published at irregular intervals, and though the details of the several lists will vary somewhat in the different groups, each list is to include, first, the accepted name (scientific and vernacular); second, reference to the original description, with record of locality; third, reference to an authentic description and illustration; and fourth, habitat and occurrence.

AMERICAN palæontologists are becoming more and more strongly convinced of the decisive character of the evidence afforded by extinct faunas of a comparatively recent con-

nection between South America, South Africa, and Australia. A short time ago, Dr. W. B. Scott, in the report of the results of the Princeton Expedition to Patagonia, announced his opinion that the fossil Santa Cruz insectivore Necrolestes is closely allied to the South African Chrysochloris, and that this relationship indicated a connection between South Africa and South America. Now Mr. W. J. Sinclair, of Princeton, in a paper published in the *Proceedings of the American Philosophical Society*, states unequivocally that Prothylacinus and the other marsupial-like carnivores of the Santa Cruz beds are true marsupials closely related to the Australian thylacine. He is, moreover, of opinion that the living South American marsupial Cœnolestes and its extinct relatives are annectant forms between diprotodonts and polyprotodonts, and are also not far removed from the ancestral stock which gave rise to the Australian phalangers. The existence of primitive opossums which cannot be regarded as ancestral to the modern South American forms is also an important determination. In view of the aforesaid relations, coupled with the evidence afforded by the invertebrate faunas, Mr. Sinclair considers himself justified in stating that "considerable evidence is now available to show that a land connection between Patagonia and the Australian region existed not later than the close of the Cretaceous or the beginning of the Tertiary, and it is possible that at this time the interchange of marsupials between the two continents was effected."

THE Carnegie Institution of Washington has published the first part of vol. i. of a "Bibliographical Index of North American Fungi," by Prof. William G. Farlow, professor of cryptogamic botany in Harvard University. This part extends from Abrothallus to Badhamia. The index owes its origin to the fact that in 1874 Prof. Farlow found it impossible to ascertain what species of fungi were known to occur in the United States, and he determined to bring together all references to North American species in the form of a card index. At the same time an authors' catalogue was started to include the titles of all works used in forming the catalogue of species. The latter catalogue was printed in 1887, and was followed by a supplemental list in 1888. A new edition with additions up to 1905 is in preparation. It was found impossible to obtain means of publication for the index until the Carnegie Institution offered to provide the funds. It is expected that the appearance of the present index will save many American institutions much time and money involved in the duplication of work. The index does not pretend to be a summary of all references to North American fungi, but is limited to those which concern the systematic mycologist, and does not include references to papers on fungicides and other technical subjects. We hope to review the index when its publication has been completed.

THE eleventh volume of the new series of the *Reliquary and Illustrated Archaeologist*, containing the four quarterly numbers published in 1905, is now available. Among contributions which will appeal to men of science are Mr. George Clinch's papers on the Neolithic dwelling and on Neolithic burial, Mr. John Patrick's essays on the sculptured caves of East Wemyss, and Mr. W. Heneage Legge's paper on glimpses of ancient agriculture and its survivals to-day. The journal makes a successful appeal to all who are interested in antiquities, architecture, the arts and industries of man in past ages, and in kindred subjects.

THE eighth volume of the *Transactions of the Rochdale Literary and Scientific Society*, dealing with the years 1903–5, has now been published. Among papers read before the society and printed in the volume the following may be mentioned:—Mr. T. Stenhouse, on the radio-activity of radium and other compounds; Mr. W. A. Parker, on the remains of fossil fishes found near Rochdale; Mr. W. H. Sutcliffe, on the bullion mine of the Upper Carboniferous rocks; Mr. C. W. R. Royds, on life in Antarctica; Mr. W. Baldwin, on the palæontology of Sparth Bottoms, Rochdale; and Mr. W. H. Pennington, on some ancient colouring matters. The latest report contained in the volume shows that the total number of members at the end of 1904 was 249, and that the society had a balance of about 66*l.* in hand. The society is to be congratulated upon its continued activity and upon the way in which, by lectures, field excursions, and other methods, it is disseminating an interest in scientific subjects.

OUR ASTRONOMICAL COLUMN.

A SUGGESTION FOR THE NEXT INTERNATIONAL SCHEME.—As the work on the international chart of the heavens is now nearing completion, Mr. W. E. Cooke, of the Perth (W. Australia) Observatory, suggests that astronomers should now begin to consider the next essential astronomical problem which should be attacked internationally. He suggests that the coordination of meridian observations is desirable, and outlines the plans on which such work might be commenced. These include the observation of fundamental stars, of about the sixth magnitude, in every part of the sky, and the formation of a main catalogue comprising, say, three stars to each square degree of the sky, that is, about 120,000 stars altogether. The accomplishment of this work would not only provide the necessary reference stars for future observations, but would give definite meridian work to a number of observatories which at present are performing it in a casual manner and often overlap each other's programmes (*Monthly Notices R.A.S.*, No. 9, vol. lxv.).

PHŒBE, THE NINTH SATELLITE OF SATURN.—Further details concerning the discovery and recognition of Saturn's ninth satellite are published by Prof. W. H. Pickering in No. 5, vol. liii., of the *Harvard College Observatory Annals*.

Prof. Pickering describes the taking and the reduction of each of the numerous plates on which the position of Phœbe has been measured. Up to the commencement of the present year 105 plates of Saturn had been secured with the Bruce telescope, and Phœbe had been recognised on 72 of these, the image on 69 of them being sufficiently well defined to be accurately measured.

On comparing these plates with others which were taken by Prof. Perrine with the Crossley reflector, it is seen that with plates having had equal exposures, and on which Phœbe is seen equally well, those taken with the reflector show stars of about one magnitude fainter than any to be found on the Bruce refractor plates.

Recent observations give the period of Phœbe as about 547·5 days, and the comparison of the observational results with the different sets of elements shows that with the revised elements the deviations are much smaller.

In No. 6 of the same volume Dr. F. E. Ross shows, in detail, the procedure followed in calculating the elements of Phœbe, and compares the three sets of elements which have been computed with the observational results. The discussion shows that slight changes in the previously determined eccentricity and period will bring the plates secured during 1898 into line with the more recent observations.

GRAPHICAL METHOD OF DETERMINING ALTITUDES AND AZIMUTHS.—A simple method of finding the altitude and azimuth of an observed body, the latitude of the observer and the declination and hour-angle of the object being known, has been devised by Mr. Littlehales, of the U.S. Hydrographic Office, and is briefly described in No. 6, vol. xxxiii., of the *Monthly Weather Review* of the U.S. Department of Agriculture.

The plan of solution employs a stereographic projection of the celestial sphere on the *plane of the observer's*

meridian, and by laying off the predetermined data on this projection—which is illustrated in the description—the observer may quickly find the required quantities.

The editor of the *Review*, Prof. Cleveland Abbe, commends Mr. Littlehales's method to the attention of all who have occasion to solve spherical triangles to the nearest minute of arc, whether in geodesy, navigation, astronomy, or general mathematical work.

THE METEORS OF BIELA'S COMET.—In No. 363 of the *Observatory* Mr. Denning directs attention to the probability of a strong shower of Andromedids this year. By quoting the observational results obtained during recent years, he shows that the shower has apparently developed into an important annual phenomenon, and he expects that the maximum display will take place on November 18, although a watch should be kept from November 17 to November 23. The position of the radiant is about R.A. $=25^{\circ}$, dec. $=+43^{\circ}$, *i.e.* near to γ Andromedæ.

THE MAGNITUDE OF η ARGÛS.—From a series of observations made at Johannesburg during May and June, Mr. R. T. A. Innes found the magnitude of η Argûs for 1905·5 to be 7·67, and its colour, on Chandler's scale, to be $7\frac{1}{2}$. On comparing these with the observations made in 1896, he finds that the change, if any, since that date is quite insignificant (*Monthly Notices R.A.S.*, No. 9, vol. lxv.).

ENGINEERING AT THE BRITISH ASSOCIATION.

BEFORE dealing with the actual work of the section, it is desirable to put on record the fact that several of the special lectures arranged by the council were exclusively engineering in their character, namely, the lectures delivered at Johannesburg by Prof. Ayrton on the distribution of power, and by Prof. Arnold on steel as an igneous rock, and the address given at Kimberley by Prof. Porter on the bearing of engineering on mining. In judging, therefore, the work done by Section G during the South African meeting, the effect produced by these lectures, delivered in all cases to large audiences, must be kept in mind.

At Cape Town the first paper read was by Mr. C. H. Smith, on colonial Dutch architecture. In this paper Mr. Smith gave a brief account of the history and development of the early architecture of Cape Colony. He pointed out that building materials were exceedingly difficult to obtain, but in spite of all difficulties the early Dutch settlers, who were men of excellent taste and education, commenced their labours on true lines. Although drawing upon the well known principles of Dutch and Batavian architecture, they adapted their buildings to the new country, and developed a style distinctly their own. It was to Governor Simon van der Stel that many of the most picturesque houses in the Cape Peninsula were due. He and his son, who succeeded him, were great builders of houses and planters of trees. The author showed a number of slides illustrating some of the quaint old houses in the Cape Peninsula and its neighbourhood, in particular at Stellenbosch, famous for its beautiful situation and surroundings. This paper proved a great attraction, and drew a large audience.

The paper by Prof. Biles, on steam turbines as applied to ocean liners, was the next dealt with. When this paper was first promised, the author hoped that detailed results of the running of the only two completed turbine ocean steamers would have been available for his paper; unfortunately this was not the case, though Prof. Biles stated that the results so far obtained had completely justified the adoption of the turbine on ocean steamers. He pointed out that such a great revolution as a change from reciprocating engines to turbine engines had never before taken place in such a short time. The author gave figures dealing with the gain in economy from an engineering point of view; in the case of the turbine steamers the *Londonderry* and the *Manxman*, as compared with the *Antrim* and the *Donegal*, designed at the same time, and having reciprocating engines, the *Londonderry* showed a total economy of 2·4 per cent. and the *Manxman* of 7·7 per cent. Prof. Biles, in summing up the work which had been done so far, stated that he was of opinion that there was every indication that in the largest installations on ocean liners there was an economy of power and cost in the use of turbines as well assured as in the case of channel steamers, and that there was little doubt that the turbine would completely displace the reciprocating engine in all moderate and high-speed liners.

Mr. How, in his paper on roller bearings, which was read in his absence by the Recorder of the section, gave some results of recent tests on line shafting when fitted with roller bearings, and on tramway and railway vehicles. In the Birmingham electric tramways it was stated that a saving of 24·3 per cent. of tractive power per ton of load was obtained, and that the net saving per car per annum would amount to 38*l*. 16*s*. 3*d*. Several railway companies had experimented with roller bearings, and in all cases a considerable economy in coal consumption had resulted. On the Liverpool overhead railway, tests proved that the reduction per ton mile of coal consumption was equal to 9 per cent., and that longer trains could be employed.

A very interesting paper was that on motor-cars in South Africa, by Mr. A. T. Hennessey. The chief object of the author was to make clear the special points in car design and construction to which attention should be paid if the motor-car is to be a success in South Africa. So far, of course, all the cars in use there are imported cars, and are built for conditions which prevail in Europe and America, and not for the conditions which prevail in South Africa. In comparing steam cars with petrol cars, Mr. Hennessey came to the conclusion that the latter were the more suitable for South African conditions; in fact, he was of opinion that the shortcomings and disabilities of the steam car were greatly accentuated by the climatic and road conditions of South Africa. The question of the cooling of the cylinders in a semi-tropical country, with roads carried up very steep hills, is most important, and very few imported cars have anything like enough water-cooling capacity. As regards springs, also, there has been great difficulty, and motorists at home have very little idea as to the strain placed upon the springs by the ordinary South African roads. In a motor-car excursion, arranged for the visiting members of the association on the Saturday of the Cape meeting, along the beautiful coast road which runs from Cape Town to Hout Bay, owing to a landslip on the mountain-side, caused by the heavy rains of July and August, the visitors had an ample opportunity of testing the kind of strain to which motor-cars are subjected in South Africa; the cars had to charge through a mass of liquid mud and stones, probably 12 inches in depth, and extending for some 100 yards along the road. In many country districts the author pointed out that it is a common occurrence for the centre of the track to be from 6 inches to 12 inches higher than the sides, which would render it impossible for a car with only a 5-inch under-clearance, which is the maximum clearance of many cars, to travel over these country roads. This paper provoked a very interesting discussion, in which the claims of the steam car were strongly upheld by one or two of the speakers.

The most important paper read before the section in Cape Town was Mr. Tippett's, on Cape Government railways. The author is one of the leading engineers in the Cape Government Railway Service, and the Government gave him every facility in the preparation of his paper. The paper formed practically a complete record of the growth of the railway industry in Cape Colony, and of the methods adopted in surveying, in constructing, and in working the railways. It bristled with statistics and figures, and there were a number of excellent diagrams and reproductions of photographs to illustrate the paper. It will form a most valuable paper for reference purposes to anyone engaged in studying the conditions of railway construction and working in our South African colonies. It is obviously impossible to give anything but a very faint notion of the contents of a paper of such length and importance in a brief summary, such as this is, of the proceedings of the section. One or two salient points to which the author devoted much attention may, however, be briefly dealt with. The one is the question of gauge. He pointed out that the original line from Cape Town to Wellington, now part of the main western system, which was constructed by a private com-

pany, was built on the 4 feet $8\frac{1}{2}$ inch gauge, but when the Government took over this line, and decided to take in its own hands the construction of the railways, acting on the advice of a strong commission, it decided to adopt 3 feet 6 inches as the standard gauge. That gauge has been adhered to throughout South Africa with the exception of one or two short branch lines, which are on the 2-feet gauge, and at the present time a 2-feet gauge line is in process of construction between Port Elizabeth and Avontuur, a coast line, which will probably be eventually extended to Cape Town. The wisdom of constructing a line such as this on a 2-feet gauge seems rather doubtful, but the large bridges on it have been put up of such a strength and of such dimensions as would enable a 3 feet 6 inches gauge to be adopted later on. Another point on which the author laid great emphasis was the system of surveying which it was necessary to adopt in a country where Ordnance maps are at present unavailable. The colonial-trained surveyors are able to carry out work with rapidity and with accuracy by the use of the tacheometer only, which would be impossible in the hands of surveyors trained only in our home methods. If a country like South Africa is to be developed by railways, it is obvious that the cost of construction must be kept down to the lowest possible figure, and, therefore, tunnels, heavy cuttings, and heavy banks must be avoided. All the members of the visiting party who travelled over the main lines in all the colonies during the visit of the association were struck with the extraordinary surface character and curvilinear meanderings of the railway lines, although by this system of construction the actual length of the lines has been in many cases increased, and the possible speed at which trains can be worked has been lessened; nevertheless, when one compares travelling, both as regards time and cost, on these lines with that in the old days with ox or mule waggons, there is no doubt that the wisest plan was to sacrifice, for the time being, possible speed for economy in construction. The Cape lines, and in fact all the lines which serve the Transvaal, suffer from the same disability as the steamer lines which ply between Europe and the Cape—heavy goods traffic is all in one direction. No less than 80 per cent. of the goods traffic on the Cape Government railways is in the shape of up-country traffic; this means necessarily a large number of empty waggons returning to the coast, and must inevitably increase freight charges.

The section opened its proceedings at Johannesburg with the president's address, which was devoted to irrigation. The subject is one of such paramount importance to South Africa that no happier choice could have been made of a president for Section G than that of Sir Colin Scott-Moncrieff. Naturally the examples selected by the president for illustration of the problem of irrigation for agricultural purposes were India and Egypt, although he had also a good deal to say with regard to the system in force in the United States and in Italy. It is to be hoped that the information placed at the disposal of South African engineers by this address will not fail to influence the trend of legislation on this question in our South African colonies.

Sir William Preece gave an interesting account of the present condition of wireless telegraphy, and his paper, bringing all the information on this question up to the most recent date, was a welcome contribution to the transactions of the section. Sir William Preece has on previous occasions contributed papers on this question to the section, and has kept the section well informed of the gradual progress in the evolution of wireless telegraphy as a practical mode of communication.

Prof. Perry's paper on the accidental breakage of winding ropes in mines concluded the first day's work at Johannesburg. In this paper certain examples were worked out in full, and in an appendix to the paper the whole of the mathematical treatment of the problem was given by the author.

The second day's proceedings were opened by Mr. Hammond with a paper on electrical power distribution for the Rand. After alluding briefly to the present tendency at home, and at such situations as the Niagara Falls, to construct large central supply stations, the author referred to the fact that he was surprised to find that this problem had not yet been taken up on the Witwatersrand. Two points were, therefore, discussed in the paper—one was whether the working of the mines could not be cheapened by the extended application of electrical power, and the second, as a corollary, whether such electrical power could not be more economically produced by a central station rather than by each mine, or group of mines, laying down its own plant. In colliery work in Great Britain there is, and has been for the last year or two, a steady growth in the application of electricity to haulage and other work in the coal mines, and the author advocated the adoption of electrical winding for the Rand mines. He also pointed out that a considerable increase of efficiency would be obtained by the abolition of the surface compressed-air plant, and by the introduction of electrically driven compressors, placed underground near the actual workings. Mr. Hammond showed that the total requirements of the Rand mines worked out at a very high figure of horse-power hours (400,000,000), and he proved by further figures that a central power station would thus have a very favourable load factor. Assuming a diversity factor of 60 per cent., and a 20 per cent. loss in distribution and transformation, he estimated the plant capacity at the central station would be 60,000 kilowatts. Basing his further calculations on these figures, the author then proceeded to work out fully the costs of generation and distribution, the revenue which could be expected, and the corresponding financial results. In concluding his communication, which was one of great value, Mr. Hammond referred to the case of the well known central power station at Newcastle-upon-Tyne, and expressed the opinion that if on the river Tyne, where coal was available in large quantities at very low rates, it paid to displace steam power by electric power, still more so would it pay on the Rand.

Mr. Dew read a short paper on water-power plants, Pilgrim's Rest, Transvaal. In this paper the author gave a list of plants in actual operation with the horse-power developed, the type of prime mover, quantity of water, and head, and dealt with a number of points of special interest in the running of such plants.

On the Friday, the last day the section met, the first paper was by Mr. C. W. Methven, on South African harbours. This paper was one of great importance, and must have involved an immense amount of work in its preparation. Practically a complete history of the harbours which have been built up round the South African coast was given. As the author pointed out, there is a remarkable absence of deep-water indentations forming natural harbours between Cape Town and Delagoa Bay, and therefore all the harbours have had to be artificially created. After giving a brief account of the Table Bay works, and the extensions now being carried out by Mr. Hammersley Heenan, the author referred to the Algoa Bay works, and the remarkable stride which had been made within the last few years in the commercial prosperity of this harbour, in spite of the difficulties due to its exposed condition and the heavy seas which frequently make approach almost impossible. Mr. Methven then discussed very fully the formation and treatment of sand-bars at the mouths of the rivers and lagoons on the south-east African coast, which render the construction of harbours and their maintenance such a difficult engineering problem.

Another valuable paper taken at this sitting was one by Mr. C. D. H. Braine, on irrigation in South Africa, dealing with the important question of the duty of water used for irrigation purposes. The author stated that there was very little information on the subject as regards South African practice, and that therefore irrigation engineers in South Africa had to be guided to a great extent by experience in other countries, such as America, Spain, India, &c. He pointed out how unskilled irrigation frequently means a waste of from 25 per cent. to 50 per cent. of water, and that many crops were actually impaired by excessive irrigation. For South Africa he was of opinion that the duty actually used on the land could be safely taken at the rate of 285 acres per cubic foot of water per second, and he quoted statistics from other countries to show that this was a reasonable allowance. To show the value of irrigation in South Africa, the author gave figures as to increase in land values;

land valued in the dry, unirrigated state at anything from 10s. to 30s. per acre was valued at rates of from 25l. to 100l. per acre when properly irrigated.

The concluding paper, by Mr. J. H. Ronaldson, dealt with the copper deposits of Little Namaqualand. The author pointed out that from the very early days it had been known that this district in the extreme west of Cape Colony, lying just south of the Orange River, and bounded on the west by the Atlantic Ocean, was a copper-producing one. As early as 1685 one of the Dutch governors dispatched a party to explore the country, but it was not until 1855 that successful work was begun. The district in which the copper mines are situated lies in the hilly ground about 50 miles from the coast, and is connected with Port Nolloth by a 2 feet 6 inches narrow-gauge railway, the property of the Cape Copper Co. During the year 1904 about 85,000 tons of ore were raised, the percentage of copper ranging from 26 per cent. to as low as 3·6 per cent. T. H. B.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE South African meeting will long be memorable to members who are especially associated with Section H, not so much on account of the high quality and interest of the papers read (though, as will be seen, these were often of considerable importance) as because it afforded an opportunity of examining, measuring, and photographing specimens of the native races, and (what was still more valuable) of visiting Bantu kraals, seeing the native in his ordinary surroundings, and witnessing some of his ceremonial rejoicings. These visits and investigations were outside the strictly sectional work, and can hardly be detailed here; but they cannot fail of permanent results in an increased comprehension of the conditions of native life and of the great problems, scientific, social, and political, connected with the native peoples of South Africa, by all who were privileged to take part in them.

Dr. Haddon's presidential address, delivered on August 16 at Cape Town, has already been printed in full in NATURE (September 7, p. 471), and need not be further referred to here than to point out its exceptionally comprehensive and useful character as a summary of our present information as to the process by which South Africa was peopled, and a sane, earnest, and timely appeal for scientific study on the spot of peoples, some of which are actually vanishing before our eyes, and the others of which are undergoing at the hands of the white race a process of so-called civilisation which will issue in a few years in the total destruction of their ancient institutions and beliefs.

The first paper read was by Mr. E. Sidney Hartland on the totemism of the Bantu. He pointed out that to the French Protestant missionary Casalis belongs the honour of being the first to note the similarity between the totemic practices and belief of the North American Indians and those of the Bantu peoples. The object of the paper was to examine the latter practices and belief, so far as they have been recorded, with the view of ascertaining how far they extend and what evidence there is of their former existence where they are no longer preserved; whether there is any essential difference between the practices and belief of the Bantu and what is generally understood by totemism elsewhere; and lastly, the process of decay. The conclusions arrived at were that, though there is little in what is recorded of the Bantu on the western side of the continent down to the southern boundary of Angola which points directly to totemism, there is sufficient to suggest that it once generally prevailed there, and that its disappearance is due to contact with the Negro; that with regard to the eastern and northern Bantu there can be no doubt about the prevalence of totemism which, though now in decay, corresponded in all essential particulars to that of other races, such as the North American Indians and the Australians; and that its decay was due to the change in the reckoning of kinship from reckoning through the mother only to reckoning through the father only, and to the ancestor-worship which had arisen upon the new social basis thereby laid.

Mr. L. Peringuey, curator of the South African Museum, followed with an address on the Stone age in South Africa. The substance of this address has been published in the volume entitled "Science in South Africa." It was illustrated by a carefully selected series of specimens from the museum, which were examined with interest in the course of an indecisive discussion which followed.

The session on Thursday, August 17, was opened by Mr. Henry Balfour with a paper on the musical instruments of South Africa. Mr. Balfour is already known as an authority on the evolution of the musical bow. In the bow of the Damaras, which is upon occasion temporarily converted into a musical instrument, he recognised an example of the earliest stage of development of a long series of instruments culminating in various forms of the harp. Other types of musical instruments were discussed, of which the most interesting, as well as the most enigmatical, was the *goura* of the Bushmen, an instrument substantially identical with the *iseba* (or *lesiba*) of the Basuto and some other Bantu tribes. On this instrument the writer had little to add to what he had previously published in the *Journal of the Anthropological Institute*. Generally as to the development of musical instruments, stress was laid on the importance of exact information with the view of determining the geographical distribution and evolution of the various types.

Miss B. Bullen-Burry read a paper discussing the social and political questions raised in the United States by the existence of the Negro in the midst of a white population. This paper dealt with an aspect of ethnology rarely brought before the section; but the state of things described by the writer and the problems involved are so similar to those even more critical in character now engaging the attention of politicians in South Africa, and on the satisfactory solution of which depends the future of the country, that it is much to be regretted that the writer had so small an audience.

On Friday, August 18, Prof. von Luschan read a paper on artificial deformation in Africa, abundantly illustrated by lantern slides. He traced all deformations of the human body to a foreign source, except possibly the tattooing in relief and the deformations of the lips.

The Rev. Canon Crisp presented a paper (which was read by the Rev. J. S. Moffat) on the mental characteristics of the Bechuana. He dwelt on the peculiarities of Sechuana grammar and construction, illustrating them by various examples. The Bantu languages will express any idea, however esoteric, and will do it with extraordinary precision and often with great felicity. A foreigner who has acquired one of them will often leave his own language to use a Bantu word, because it conveys his thought more aptly and tersely. Bantu proverbs and metaphors are often most incisive, emphasising with much power and delicacy what it is intended to say. The Bechuana are accustomed to use their proverbs without any introduction, their rapidity of thought enabling both speaker and hearers at once to locate the idea to be conveyed. They are masters in the art of destructive criticism, and their native shrewdness, observation, and wit render them dangerous disputants. Instances of the facility with which Bantu acquire European learning and adapt themselves to European thought were given. This paper aroused much interest on the part of the over-sea members who heard it, and numerous questions on details were addressed to Canon Crisp, though of discussion strictly speaking there was none.

A short paper by Mr. William Grant was read giving an account of a visit in March, 1894, to Magato, the then chief of the Mawenda in the Transvaal. The business of the Cape Town meeting was then closed by the president with a few appropriate words of appreciation of the assistance rendered by Mr. Peringuey, who had kindly acted as local secretary, and of the kindness with which the visitors from the Mother Country had been received.

The session at Johannesburg was opened on Tuesday, August 29, with a paper by Dr. S. Schönland, on arts and crafts among the natives of South Africa, containing a summary of present knowledge on the subject.

A paper followed by Mr. W. A. Squire on the art of the Bushmen. It was illustrated by the exhibition of copies of a number of Bushman drawings, on which the author

commented. The methods by which the artist achieved such wonderfully spirited and life-like results were simple indeed. Coloured earth, pounded stones, charcoal, blood, and bird-fat constituted his pigments. A flat stone was his primitive palette. His brushes were perhaps made of the coarse hair of the male wildebeeste or buffalo. Elsewhere he scratched on the walls of his rock-shelter with a stone a little harder than the surface to be adorned. Much interest is obviously shown in the details. Obscenity, as such, is rare. By way of illustration of the technique of these drawings, a copy of a Bushman battle picture from the Natal side of the Drakensberg Range, near Bushman's Pass, and an unpublished drawing by a member of the Kamilaroi tribe of eastern Australia were exhibited, and compared to the disadvantage of the latter in strength, vividness, and accuracy of portrayal. Finally, the object and meaning of the drawings were touched upon, but not discussed, by the author, possibly because too little is known as yet; perhaps too little ever will be known to give rise to more than conjecture. It may be observed, however, that the late Mr. G. W. Stow, the author of a book recently published on the natives of South Africa, formed a large collection of copies of Bushman drawings. These were examined by the president and several members of the section after the meeting was over, and a strong desire was expressed that they should be published. If this could be done, a careful collation might result in some conclusions as to the motives which prompted and the circumstances which developed these remarkable exhibitions of artistic power by a people usually accounted so low in the scale of humanity—conclusions which might, moreover, throw unexpected light on the similar memorials left by the palæolithic people of central France.

A descriptive summary of recent discoveries of stone implements in South Africa was presented by Mr. J. P. Johnson.

Mr. A. E. Mabille read a paper on the Basuto. As a grandson of the famous missionary Casalis, who had lived (except for a few years when he was completing his education at Paris) his whole life in touch with the people, the author was specially fitted to deal with the subject; and the paper was valuable for the statistics it contained and the picture it offered of the present condition and customs of the Basuto under the British protectorate. In the discussion which followed some exception was taken to the use of the word *Modimo* for *God*, but the author defended its use on the ground that it was the word long ago adopted by the missionaries, and, whether rightly or wrongly adopted at that time, its use was now fully understood and accepted among the Basuto themselves.

On Wednesday, August 30, Prof. von Luschan read a paper on the racial affinities of the Hottentots, in which he contended, mainly on the evidence of the Hottentot language, that the Hottentot were a Hamitic people which had come into contact with the Bushmen and absorbed Bushman characteristics. Apart from a few roots and clicks, he declared the Hottentot language to be strictly Hamitic. On the physical side, the loss of their original high stature and the acquisition of steatopygia and of the spiral curled hair of the Bushman have been the penalties of intermarriage with the pigmy people.

Mr. Randall MacIver exhibited and described a number of lantern slides of the Rhodesian ruins. His report on his recent examination of the ruins was read in greater detail at an evening meeting at Bulawayo. It may here be said, however, that he has with some probability established by his researches the native origin of the ruins, and shown that most of them are of no great antiquity, in no case going back to more than 600 or 700 years. They are essentially Bantu kraals in stone. Great Zimbabwe he identified with the capital of Monomotapa, as described by the earlier Portuguese travellers. All the problems connected with the ruins are not yet solved. We are still ignorant what gave the artistic and military impulses to the erection of these structures, against what enemy they were planned, and what led to their ruin and abandonment. These matters can only be determined, if at all, by accurate scientific exploration, and not by mere speculation like much of that which has been hitherto wasted upon these mysterious remains.

Not the least important day in this section was Friday, September 1. Besides papers by the well known missionary M. Junod on the Thonga tribe (illustrated by an interesting exhibition of native music, both vocal and instrumental), and by Mr. J. W. Shepstone, C.M.G., giving a general sketch of the native tribes, two striking communications were read, the one by the Rev. E. Gottschling on the Bawenda, and the other by the Rev. W. C. Willoughby on the totemism of the Bechuana. Mr. Gottschling's paper was partly historical, partly descriptive, and gave a number of particulars hitherto unpublished relating to the Bawenda, a tribe of Bantu in the north-east of the Transvaal, and their customs and beliefs. Some of the details were of quite extraordinary interest. Mr. Willoughby's paper was a discussion of a number of points connected with the totemic practices and of the relation to them of various ceremonies not usually regarded as totemic in origin, in which oxen and certain vegetables play an important part. The writer's conclusions were open to much debate, for which little time was found. The paper, however, as a whole was so suggestive, directing attention to aspects of the Bantu religious ceremonies other than those from which they are usually regarded, that it will be a great pity if this paper, as well as that of Mr. Gottschling, be not published in some form accessible to anthropologists.

The business of the section was wound up with graceful words of thanks by the president to the local committee, and in particular to Mr. A. von Dessauer, the local sectional secretary, to whose energy, forethought, and organising ability the success of the Johannesburg meeting was so largely due.

THE SOLAR OBSERVATORY ON MOUNT WILSON, CALIFORNIA.[1]

In a report entitled "A Study of the Conditions for Solar Research at Mt. Wilson, California," an outline was given of the circumstances that have resulted in the establishment of a solar observatory on Mount Wilson by the Carnegie Institution of Washington. At the recent annual meeting of the board of trustees, a grant of 150,000 dollars was authorised, for use during 1905. It is expected that the first equipment will cost about twice this sum, and that important additions will result in the future from the operation of a large and well appointed instrument and optical shop.

In April, 1904, a grant of 10,000 dollars was made by the executive committee of the Carnegie Institution for the purpose of bringing the Snow telescope to Mount Wilson from the Yerkes Observatory. An expedition for solar research was accordingly organised under the joint auspices of the University of Chicago and the Carnegie Institution, with the understanding that the funds granted by the Carnegie Institution would be used for the construction of piers and buildings, and for other expenses incidental to the work, while the University of Chicago would furnish the instrumental equipment and pay the salaries of some of the members of the party.

It is a fortunate circumstance that the construction and use of a great reflecting telescope, with a five-foot mirror, is in the general plan of research laid down for the Solar Observatory. In "Year Book" No. 2 (p. 49) of the Carnegie Institution may be found a report on this subject, prepared at the request of Profs. Boss and Campbell, my colleagues on the committee, and improved in many particulars as the result of their criticisms. The prime object of the Solar Observatory is to apply new instruments and methods of research in a study of the physical elements of the problem of stellar evolution. Since the sun is the only star near enough the earth to permit its phenomena to be studied in detail, special attention will be devoted to solar physics. It is hoped that the knowledge of solar phenomena thus gained will assist to explain certain stellar phenomena. Conversely, the knowledge of nebular and stellar conditions to be obtained through spectroscopic and photographic investigations with the

[1] Abridged from No. 2 of "Contributions from the Solar Observatory of the Carnegie Institution of Washington," by Prof. G. E. Hale, director of the Observatory

five-foot reflector should throw light on the past and future condition of the sun. All the principal researches will thus be made to converge on the problem of stellar development. The name "Solar Observatory" is regarded as appropriate, since the spectroscopic study of stars and nebulæ, to be carried on in connection with the solar work, are essential elements in any attempt to determine the mode of origin, the development, and the decay of the sun as a typical star.

How, then, shall we attack in an effective manner the complex problem of stellar evolution? It goes without saying that I can offer no general answer to this question; I can only point out the three principal lines of attack which we hope to pursue at the Solar Observatory. These involve:—

(1) The more complete realisation of laboratory conditions in astrophysical research, through the employment of fixed telescopes of the cœlostat type, and through the adoption of a *coudé* mounting for the five-foot reflector. This should permit (*a*) the use of mirrors or objectives of great focal length, thus providing a large image of the sun for study with spectroscopes and spectroheliographs; (*b*) the use of long focus grating spectroscopes, mounted in a fixed position in constant temperature laboratories, for the photography of stellar spectra requiring very long exposures; (*c*) the use of various laboratory instruments, such as the radiometer, which cannot be employed in conjunction with moving telescopes.

(2) The development of the spectroheliograph in the various directions suggested by recent work at the Yerkes Observatory, including the photography of the entire solar disc with dark lines of hydrogen, iron, and other elements; further application of the method of photographing sections of flocculi corresponding to different levels; special studies of sun-spots, &c.; and daily routine records of calcium and hydrogen flocculi and prominences.

(3) The construction of a five-foot equatorial reflector, with *coudé* mounting, and its use in the photography of nebulæ, the study of stellar and nebular spectra, and the measurement of the heat radiation of the brighter stars.

It was originally intended that a prolonged series of determinations of the solar constant, extending over at least one sun-spot period, should be made an important feature of the observatory's work. The plans outlined in "Year Book" No. 2 accordingly included an equipment at Mount Wilson for this purpose, and suggested, in harmony with Dr. Langley's view, that provision be made for two additional stations, one near the summit of a high mountain, at an elevation of about 12,000 feet, the other at a much lower level on the same mountain. The principal purpose of these two stations was to measure the atmospheric absorption, in order to eliminate it from the solar constant determinations. The recent developments of Dr. Langley's researches at Washington have led Mr. Abbot, who is associated with Dr. Langley in the work, to the conclusion that entirely satisfactory results can be obtained there by the method employed. The poor atmospheric conditions with which the Washington observers have so successfully contended, and the disturbances arising from ground tremors in the heart of a large city, would be largely eliminated at Mount Wilson. For this reason it seems probable that results of higher precision could be obtained at this site.

In addition to the above mentioned observations, provision will be made at Mount Wilson for various laboratory investigations necessary in conjunction with solar research. In view of the importance of securing a complete record of solar phenomena when magnetic storms are in progress, suitable magnetic apparatus, recommended by Dr. L. A. Bauer, in charge of the department of terrestrial magnetism of the Carnegie Institution, will be installed at a sufficient distance from the electrical machinery.

As no description of the Snow telescope has been published, the present brief account may be prefaced by a statement regarding the construction of the telescope.

In 1900, after Prof. Ritchey had succeeded Prof. Wadsworth as superintendent of instrument construction at the Yerkes Observatory, a cœlostat with mirror of 15 inches (38 cm.) aperture was made, from Prof. Ritchey's designs, for the total solar eclipse of that year. This gave such satisfactory results that the plan of constructing a large cœlostat was again taken up. Unfortunately, however, no funds were available for this purpose. In 1901, during a visit to the observatory of Prof. Cross, chairman of the Rumford committee, I showed him the details of the instrument, as worked out by Prof. Ritchey. The design called for a cœlostat of 30 inches (76 cm.) aperture, with second plane mirror of 24 inches (61 cm.) aperture, the latter mounted so as to slide north-east and south-west on rails lying east of the cœlostat. The concave mirror, to which the light was reflected from the second plane mirror,

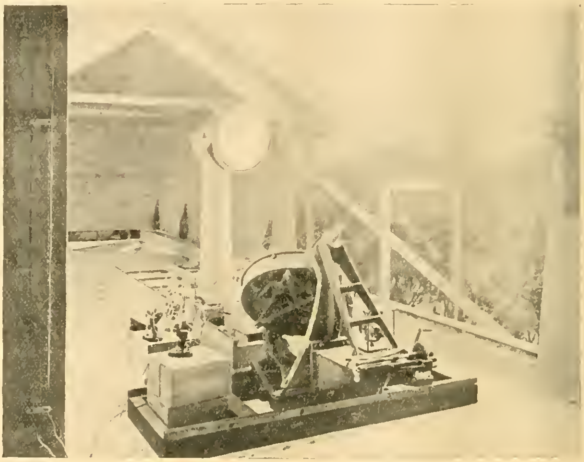


FIG. 1.—The Snow Telescope when mounted at the Yerkes Observatory.

had a focal length of 61 feet, and a second concave mirror, of 165 feet (50·3 m.) focal length, was also to be used.

At the kind suggestion of Prof. Cross, a grant of 500 dollars was made by the Rumford committee in aid of an investigation to be undertaken with this telescope. Subsequently, through the kindness of Prof. Pickering, chairman of the Draper committee, two other grants, of 500 dollars each, became available. With these funds, helped out by small amounts obtained from other sources, the work was begun.

A gift of 10,000 dollars from Miss Helen Snow, of Chicago, in memory of her father, the late George W. Snow, provided sufficient funds to complete the telescope and to instal it in a suitable house. The cœlostat was mounted on a brick pier, at a height of 15 feet (4·57 m.) above the ground. In Prof. Ritchey's design of the previous instrument the rays were reflected in a north-easterly direction from the cœlostat mirror to a second plane mirror, which sent them toward the south-west to one or the other of the concave mirrors. In designing the Snow telescope, a new arrangement of the second mirror was adopted by Prof. Ritchey, at the suggestion of Mr. C. G. Abbot. As Fig. 1 indicates, the light is reflected upward and to the south from the cœlostat mirror to a

second plane mirror, mounted in a fork at the upper extremity of an iron column, on a carriage which can be moved along heavy iron rails. The position of this carriage on the rails depends upon the declination of the observed object; with a low sun the second mirror stands close to the cœlostat, but with a high sun it must be moved away in order to intercept the reflected beam. The cœlostat itself may be moved east or west on its own rails, so that a low object near the meridian may not be hidden by the second mirror or its support.

With the exception of the solar and stellar spectroscopes, for which suitable gratings could not be obtained, the Snow telescope was practically completed in the autumn of 1903. On October 3 of that year it was formally presented to the University of Chicago by Miss Snow, in the presence of a number of guests.

In designing the new cœlostat house on Mount Wilson I was influenced by two principal considerations:—(1) The importance of placing the cœlostat as far as possible above the ground, which had been indicated by observations made with a telescope in a tree at elevations ranging from 20 feet to 70 feet; (2) the importance of constructing the house in such a way as to reduce to a minimum the heating and the radiation of the floor, walls, and ceiling, with the purpose of keeping the air within the house at the same temperature as the outer air.

The cœlostat, and the supports for the plane mirror and the 60-feet concave mirror, are now in place on the piers, but heavy storms have prevented the mirrors from being mounted. The concave grating stellar spectrograph is nearly ready to be set up, and work is well advanced on the smaller of the two spectroheliographs. The ultraviolet glass prisms and lenses for the stellar spectrograph have been completed by the Carl Zeiss Company, and orders have been placed for the optical parts of the 30-feet spectroheliograph and the Littrow spectrograph. Through the courtesy of the president and trustees of the University of Chicago, the Snow telescope and some of its accessories will be used by the Solar Observatory for some time. It will subsequently be replaced by a similar telescope constructed in our own instrument shop.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following examiners have been appointed in the science schools:—in physics, Mr. W. C. D. Whetham; in anatomy, Mr. A. H. Young; in physiology, Mr. Leonard Hill; in pathology, Dr. E. W. Ainley Walker; in forensic medicine, Dr. A. L. Ormerod; in medicine, Dr. J. R. Bradford; in surgery, Mr. H. J. Stiles; in obstetrics, Sir Arthur V. Macan; in preliminary physics, Mr. C. E. Haselfoot; in preliminary chemistry, Mr. A. Angel; in preliminary botany, Prof. J. Reynolds Green.

The Burdett-Coutts scholarship for 1905 has been awarded to Mr. James A. Douglas, Keble College.

The Junior Scientific Club held its 276th meeting in the museum on November 8. Prof. Gotch exhibited the Gotch ophthalmic spinthariscope, and Dr. H. M. Vernon read a paper on the chemical constitution of protoplasm.

CAMBRIDGE.—The election of the well known scholar Mr. F. C. Burkitt, of Trinity College, to the Norrisian chair of divinity has a certain interest outside theological circles. It is, we believe, the first time that a layman has been elected to a chair of theology in the University of Cambridge. The Norrisian chair is open to laymen, but until this year has invariably been held by clergymen. That the heads of houses, who form the electing body, should have made this departure is perhaps a sign of the times.

Mr. C. T. R. Wilson, Sidney Sussex College, has been re-appointed demonstrator of experimental physics for a period of five years from Michaelmas, 1905.

On Monday, November 6, the following were elected to vacant fellowships at St. John's College:—Mr. J. W. H. Atkins, lecturer in English at the Victoria University, Manchester, and Mr. Frank Horton, for research in physics, 1903, Allen student, 1904; D.Sc. London and Mackinnon student of the Royal Society. Mr. Horton joined the university as an advanced student.

IN connection with Sir Donald Currie's offer of 20,000*l.* to Queen's College, Belfast, on condition that a similar sum is raised by those interested in the welfare of the college, President Hamilton announced on November 11 that subscriptions forthcoming to that date amount to nearly 16,000*l.* The remainder of the sum must be subscribed, according to Sir Donald Currie's conditions, before Christmas.

WE learn from *Science* that Mr. Andrew Carnegie has offered 20,000*l.* to Union College, for an engineering building, on condition that the institution raises a like amount for this purpose. Mr. Carnegie has also offered to give Smith College one-half of 25,000*l.* required for a biological laboratory. It is worthy of note that the first of the initial group of seven structures that form the new Carnegie Technical Schools, in Pittsburg, Pennsylvania, has been opened with a class of 120 students, selected from more than 600 applicants.

THE Department of Agriculture and Technical Instruction for Ireland will award in July, 1906, not more than ten open scholarships and ten limited scholarships to assist students of domestic economy to undertake the full course of instruction at the Irish Training School of Domestic Economy, Dublin. Scholarships will entitle the holders to free admission to the full course of training. The school is not residential, and no subsistence allowance is given. The scholarships will be awarded as the result of a competitive examination. Forms of application may be obtained from the secretary of the department after January 1, 1906.

A *Times* correspondent reports that the trustees of the Witwatersrand Council of Education have decided to dispose of a sum of 115,000*l.*, raised in 1899 to provide elementary education for the Uitlander community, in the following manner. The Transvaal Technical Institute is to receive 60,000*l.*, and 30,000*l.* is to be used to found a public school at Frankenwald on the lines of an English public school. The remaining 25,000*l.* will probably be divided between Jeppestown High School and Johannesburg College, but is held over until the publication of the report of the Government Commission on Secondary Education.

IT is announced that a school for post-graduate medical study, to be named "The London School of Clinical Medicine," is to be established by the Seamen's Hospital Society at the *Dreadnought* Seamen's Hospital, Greenwich. The hospital contains 250 beds, and by the addition of eminent members of the medical profession to the present staff, and by an affiliation for teaching purposes with other special hospitals south of the Thames, it is hoped that a complete curriculum for post-graduate study may be arranged. The new school will be complemental to the same society's School of Tropical Medicine at the Albert Dock, which has proved such a success.

AT the session of council of University College, London, on November 6, the following resolution was adopted and ordered to be communicated to Mr. Bawden and Mr. Speyer:—"That the most grateful thanks of the council be offered to Mr. E. G. Bawden and Mr. Edgar Speyer for providing and allotting the sum of 16,000*l.*—to be known as 'the Bawden Fund'—to the fund for advanced university education and research, thereby making up the balance of the sum of 200,000*l.* necessary to complete the financial arrangements for the incorporation of the college in the university. The council are of opinion that by promoting the incorporation of the college in the university they can most effectually realise the purposes for which the college was founded and can best advance the cause of learning and science. They therefore feel that they can congratulate Mr. Bawden and Mr. Speyer on helping to complete an arrangement that is likely to have a far-reaching influence in the furtherance of advanced education and research in London."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, July 20.—"The Influence of Phase Changes on the Tenacity of Ductile Metals at the Ordinary Temperature and at the Boiling Point of Liquid Air." By G. T. **Beilby** and H. N. **Beilby**, B.Sc. Communicated by Prof. J. Larmor, Sec.R.S.

The observations recorded in this paper are intended to prepare the way for a more direct attack on the problems of molecular cohesion by the establishment of clearer views as to the influence of changes of phase on the tenacity of ductile metals at various temperatures.

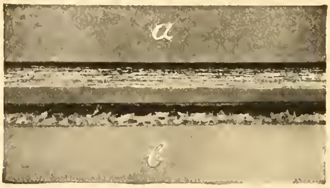


Fig. 1.

Fig.

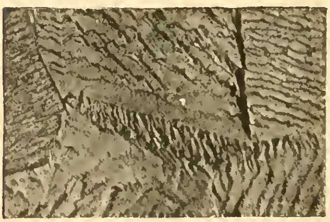


Fig.

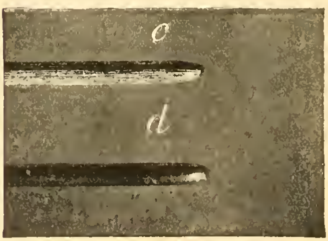


Fig. 4.

According to the phase theory of the hard and soft states in metals which was first developed by one of the authors more than a year ago, the changes of state from hard to soft and from soft to hard were shown to be due to the changes of phase brought about, in the one case by heat, and in the other by mechanical deformation or flow. In the ductile metals the crystalline is the mechanically unstable phase, while the amorphous only becomes thermally unstable when a definite temperature is reached.

The comparative mechanical instability of the two phases is well illustrated in the stretching of wires under tension. Annealed wires, which are in the **C** phase, stretch when they are stressed beyond the yield point; hardened wires, which are partly in the **A** phase, do not stretch—they break without extension when their limit of tenacity is reached.

The homogeneous **C** phase in ductile metals has no true breaking point—it yields and stretches when stressed beyond the elastic limit, and in so doing it passes partly into the **A** phase, and rupture occurs at the breaking point *of the mixed structure*. The tenacity of the mixed structure approaches, but never quite reaches, that of the homogeneous **A** phase. For the purpose the authors had in view it was necessary to obtain the metals as nearly as possible in this homogeneous condition.

Wire drawing was the means employed for the breaking down of the **C** phase. After a wire had been stretched to four or five times its original length by drawing it through the holes of a wire plate, all the ordinary traces of crystalline structure disappeared, but it still consisted of minute granules of the **C** phase embedded in a matrix of the **A** phase. Further drawing at the same temperature alters the mixed structure only slightly; for each temperature there appears to be a certain mechanical equilibrium between the phases. By lowering the temperature of drawing, the **C** phase is further broken down into still smaller granules, and the mixture approaches more nearly to the homogeneous **A** state.

(*a*) Fig. 1 is a photograph of a gold wire which has been etched after drawing. The flow lines near the surface consist of rows of granules. (*b*) On the same photograph, shows the effect of heating another piece of the same wire to about 400°. Removal of the surface by etching now discloses the fully developed crystalline grains with their differently oriented lamellæ. The thermal transformation from **A** to **C** has taken place, and the wire is restored to the soft condition. Figs. 2 and 3 are photomicrographs at higher magnifications, which show the details of structure more fully. Fig. 2 is the granular structure by oblique light at a magnification of 250, and Fig. 3 is the crystalline structure by normal light at a magnification of 700.

The observations were made on wires which had been as completely as possible converted into the **A** phase by wire drawing at the ordinary temperature, and in every case the tenacity observed was higher than any which had been recorded by previous observers for equally pure metals.

	Tons per square inch
Gold. Purity—9,997 per 10,000	
Tenacity at 288° absolute (15° C.)	15·6
,, 53° ,, (−180° C.) ..	22·4
Silver. Purity—10,000 per 10,000	
Tenacity at 288° absolute (15° C.)	25·7
,, 53° ,, (−180° C.) ..	34·4
Copper. Purity—9,996 per 10,000	
Tenacity at 288° absolute (15° C.)	28·4
,, 53° ,, (−180° C.) ...	36·0

The wires broken at the ordinary temperature showed no general stretching. There was a slight extension of from ½ per cent. to 1 per cent., due entirely to a sharp reduction of diameter at the actual point of rupture. At the boiling point of liquid air all the wires stretched from 11 per cent. to 12 per cent. This stretching was uniform over the whole length between the grips. This was confirmed by exact measurements of the diameter at a number of points.

The appearance of the fractured ends revealed several points of interest. In every case the copper wires showed the cupped formation at the extreme end. This formation is evidently due to the lower tenacity of the central core, due to the presence of gas bubbles which have been drawn out into long tubes or cells. The silver wires occasionally showed a slight cupped formation, but in this case the gas bubbles to which it was due were globular, as if they had been evolved at the moment of fracture. The gold wires were practically free from sponginess, and the fractures were almost perfectly viscous (Fig. 4).

By drawing wires at the lowest possible temperatures the authors hope to obtain the ductile metals in their condition of maximum tenacity, and from the figures then

available to be able to calculate the molecular cohesion at the absolute zero.

July 29.—"Studies on Enzyme Action. VIII.—The Mechanism of Fermentation." By E. Frankland **Armstrong.** Communicated by Prof. H. E. Armstrong.

The experiments described, which were begun in the Carlsberg Laboratory, Copenhagen, were undertaken to ascertain, if possible, the manner in which the activity of the various organisms giving rise to alcoholic fermentation is dependent on, or influenced by, the enzymes which they contain. The action of twenty selected yeasts on each of the four hexose sugars glucose, fructose, mannose and galactose, and on the disaccharides cane sugar, maltose and milk sugar, was investigated. All the yeasts tested were able to ferment glucose, mannose and fructose, but quite a number were unable to ferment galactose. It is shown that inability to ferment galactose has nothing to do with the absence from the yeast of any one of the sucroclastic enzymes, since yeasts are to be found which are without action on galactose; in fact, the fermentation of glucose and galactose is brought about by different mechanisms.

The results further indicate that the power of a yeast to ferment mannose, glucose or fructose is clearly in no way conditioned by the presence of a particular sucroclastic enzyme; indeed, it would seem that the occurrence of alcoholic fermentation is altogether independent of the presence of an enzyme—whether free or fixed—able to induce the hydrolysis either of maltose or of sucrose.

The fact that the three hexoses which behave alike have one common enolic form is of utmost significance as an indication that the formation of the enol is the initial stage in the fermentation of the hexose, and that the breakdown of the molecule commences at the terminal carbon atom.

Chemical Society, November 2.—Prof. R. Meldola, F.R.S., president, in the chair.—Molecular conductivity of water: P. **Blackman.**—The stereoisomerism of substituted ammonium compounds: H. O. **Jones.** Wedekind's supposed β-phenylbenzylmethylallylammonium iodide is proved to be in reality *phenylbenzyldimethylammonium iodide.* At present optical activity is the only evidence of stereoisomerism of quinquevalent nitrogen compounds of the type Nabcd,X, and the hypothesis suggested by the author (*Trans. Chem. Soc.,* 1903, lxxxiii., 1403), slightly developed, is adequate to explain all the known facts.—Note on the fluorides of selenium and tellurium: E. B. R. **Prideaux.** The fluorides of selenium and tellurium are gaseous substances, easily condensable by cold, forming white, snow-like solids. They have the formulæ SeF_6 and TeF_6.—The constitution of glutaconic acid: J. F. **Thorpe.**
Some alkyl derivatives of glutaconic acid and of 2:6-dioxypyridine: H. **Rogerson** and J. F. **Thorpe.**—Note on the formation of β-methylglutaconic acid and of αβ-dimethylglutaconic acid: F. V. **Darbishire** and J. F. **Thorpe.**—The influence of water and alcohols on the boiling point of esters. A modification of Markownikoff's method of preparation: J. **Wade.** The Markownikoff interaction proves on investigation to proceed in most cases readily at 100°, and in presence of any strong acid; it may be modified to afford a general and practically automatic method of preparing the lower alkyl esters of such acids as formic, acetic, propionic, and butyric.—Note on bromine fluoride: E. B. R. **Prideaux.** Fluorine when passed over bromine combines with it to form a pale yellow liquid, which freezes to a white solid, melting at −2°, and which probably has the formula BrF_3.—Solution and pseudo-solution: E. **Linder** and H. **Picton.** The authors discuss (1) the physical and chemical properties of colloidal arsenious sulphide; (2) the physical and chemical properties of colloidal ferric hydroxide; (3) dyeing, a phase of coagulation.—The influence of very strong electromagnetic fields on the spark spectra of ruthenium, rhodium, and palladium: J. E. **Purvis.** The general results showed that (1) most of the lines are divided into triplets, and that there is a periodic or rhythmic change in the direction of the vibrations of the constituents of the triplets; (2) some lines become quadruplets, and within certain definite regions of the spectrum their constituents also change the directions of their vibrations; (3) other lines become doublets; (4) the inner member of the triplets is usually the strongest; (5) the strongest spectral lines are not the most widely separated when vibrating in the field; and (6) the decrease in the width of the triplets does not proceed *pari passu* from the less to the more refrangible end of the spectrum.—A volumetric method of estimating the cinchona alkaloids by means of their double thiocyanates: P. W. **Robertson.** Notwithstanding the complexity of double salts of this type, the determination of the amount of thiocyanate removed from solution by the alkaloids forms an accurate and speedy volumetric method of estimating quinine in the commercial drugs and in the assay of the crude cinchona bark.—The osmotic pressure of sugar solutions in mixtures of alcohol and water: P. S. **Barlow.**

Mathematical Society, November 9.—Prof. A. R. Forsyth, president, in the chair.—The De Morgan medal was presented to Dr. H. F. Baker.—On improper double integrals and On the arithmetic continuum: Dr. **Hobson.** In the first of these papers necessary and sufficient conditions are obtained in order that a double integral, of which the integrand becomes infinite at an infinite number of points within the domain of integration, can be transformed into a repeated integral, so as to be capable of being evaluated by successive integrations with respect to two variables. The second paper deals with some criticisms by J. König levelled against the fundamental notions of the theory of sets of points and with the possibility of a general construction of all irrational numbers. It is shown how a general definition of all numbers rational or irrational can be obtained, and that the set of numbers constructed by means of the definition has the essential properties of the continuum, that is to say, it is at once "perfect" and "connected."—On the arithmetical nature of the coefficients in a group of linear substitutions of finite order (second paper): Prof. W. **Burnside.** An irreducible group of linear substitutions being given in any one of its possible forms, it may be possible to choose new variables so that, when expressed in terms of them, the coefficients of the substitutions belong to an assigned domain of rationality. The simplest domain of rationality for which this could be possible is that defined by the characteristics of the group. It is shown that, in general, apart from certain exceptional cases, it is possible to exhibit the group so that the coefficients belong to the domain of rationality defined by the characteristics. The result is obtained without introducing the theory of the reduction of the group when regarded as a permutation-group.—The continuum and the second number-class: G. H. **Hardy.** The paper is a reply to a criticism by Dr. Hobson of a construction for certain transfinite numbers given by the author in the *Quarterly Journal of Mathematics,* vol. xxxv.—On the asymptotic value of a type of finite series: J. W. **Nicholson.**—On an extension of Dirichlet's integral: Prof. T. J. I'A. **Bromwich.**

Paris.

Academy of Sciences, November 6.—M. Troost in the chair.—On the mixed derivatives of dextrorotatory camphoric acid and on β-campholide: A. **Haller** and G. **Blanc.** The esterification of camphoric acid by methyl alcohol and hydrochloric acid gives poor yields, the acid ester being produced in considerable quantity. By treatment with phosphorus trichloride, the latter forms the corresponding chloride, from which the neutral ester can be quantitatively obtained by treatment with methyl alcohol. The compounds obtained by the action of ammonia and phenylhydrazine upon the chloride are also described, and the preparation of the β-campholide by the reduction of the neutral methyl ester with sodium. The yields of the latter ester are poor, and the attempt to prepare from it an isomeric cyanocampholic acid was not successful.—The evolution of the Tertiary mammals: the importance of migrations: Ch. **Depéret.** The author emphasises the importance of an exact study of the migrations of mammals at different periods in order to explain the appearance of a given group in strata not containing their immediate predecessors, and gives details for the Eocene fauna.—On recurrent convergent relations: Pierre **Boutroux.**—On a certain category of functions: H. **Padé.**—On the impossibility of negative impulse waves in gases: Győző **Zemplén.** An impulse wave is a surface propagated in a

gas the density and velocity of which undergo abrupt variations. Such a wave is not purely adiabatic, even when the gas is isolated from all sources of external heat. In the case of a positive wave the gas itself is a source of heat, and the entropy of the system increases; the inverse case is not possible.—Remarks on the preceding note: M. **Hadamard.** Researches on gravitation: V. **Crémieu.** It is shown that it is possible to repeat the Cavendish experiment in liquids under conditions equal, if not superior, to those realised in air.—On the electrical conductivity of selenium: Maurice **Coste.** The selenium in these experiments was placed between gold plates 1 mm. apart. The gold has the advantage over other metals of not forming a selenide, the conductivity of which might interfere with the accuracy of the results. If the selenium is rapidly cooled, the resistance is above 50 megohms, but after annealing it falls to some thousand ohms. It has been found that to obtain a selenium that is very sensitive to the action of light it is necessary to have it in the metallic state in a form as compact as possible.—The determination of calorific conductivity: J. **Thovert.**—The ultra-violet spectra of the purins: Ch. **Dhéré.** Thirteen photographs were made on the same plate, the first being the comparison spectrum, the others the absorption spectra of the aqueous solution of the purin considered with progressively increasing thickness. Results are given for 6-oxypurin, xanthin, and uric acid.—On the reduction of oxides and on a new method of preparation of the compound $SiMn_2$ by means of aluminium: Em. **Vigouroux.**—Molecular transpositions and the migration of carboxyl in the dehydration of certain acid-alcohols: E. E. **Blaise** and A. **Courtot.** The ethyl ester of ββ-dimethyl-β-phenylhydracrylic acid, under the influence of phosphoric anhydride, gives dimethylatropic acid. The removal of water in this reaction must have been preceded by the migration of the carboxyl group, and furnishes the first example of such a migration.—On the crystallography of a double compound of ammonium chloride and nickel bromide: Fréd. **Wallerant.**—Rheotropism of some hydroids: Paul **Hallez.**—Experiments on the toxicity of eggs: Gustave **Loisel.** The yolks of the eggs of the chicken, duck, and tortoise contain substances which, when injected into the veins, under the skin, or in the general cavity of the body, determine promptly the death of the injected animals.—Contribution to the study of Corti's organ: M. **Marage.**—On the nature of the pigments of the blood: MM. **Piettre** and **Vila.** The author has repeated Nencki's work on the composition of Teichmann's crystals, and obtains analytical results for the substance which vary with varying conditions of preparation, and hence concludes that the formula attributed to the substance is illusory.—Researches on the fatty acids. Experimental lesions: Jean **Camus** and Ph. **Pagniez.** On the age of the Vire granite: A. **Bigot.**—On the parallelism of the Upper Eocene strata of Biarritz and Vincentin: Jean **Boussac.** On the storm of July 4 in the district of Orleans: M. **Maillard.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16

ROYAL SOCIETY, at 4.30.—The Physical and Chemical Properties of Iron Carbonyl: Sir James Dewar, F.R.S., and H. O. Jones.—The Transit of Ions in the Electric Arc: A. A. Campbell Swinton.—First Photographs of the Canals of Mars: Prof. Percival Lowell.—On the Laws of Radiation: Prof. J. H. Jeans.—The Pressure of Explosions. Experiments on Solid and Gaseous Explosives: J. E. Petavel.—The Accurate Measurement of Ionic Velocities: Dr. R. B. Denison and Dr. B. D. Steele.—On Newton's Rings formed by Metallic Reflection: Prof. R. C. Maclaurin.—The Electrical Conductivity of Dilute Solutions of Sulphuric Acid: W. C. D. Whetham, F.R.S.

CHEMICAL SOCIETY, at 8.30.—Silicon Researches, Part ix., Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (SiN): J. E. Reynolds.—Condensation of Ketones with Mercury Cyanide: J. E. Marsh and R. de J. F. Struthers.—Application of the Microscopic Method of Molecular Weight Determination to High Boiling Solvents: G. Barger and A. J. Ewins.—Green Compounds of Cobalt produced by Oxidising Agents: R. G. Durrant.—Synthesis of Tertiary Menthol and of Inactive Menthene: W. H. Perkin, jun.—Optically Active Reduced Naphthoic Acids, Part i., Dextro-$\Delta^{(2 \text{ or } 3)}$-dihydro-1-naphthoic Acid: R. H. Pickard and A. Neville.

LINNEAN SOCIETY, at 8.—Contributions to the Embryology of the Amentiferæ: Dr. Margaret Benson, Elizabeth Sanday and Emily Berridge.—On the Ears of certain Sharks: Prof. Chas. Stewart, F.R.S.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Seventh Report to the Alloys Research Committee; On the Properties of a Series of Iron Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, R. A. Hadfield, and P. Longmuir.

MONDAY, NOVEMBER 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—First Exploration of the Hoh-Lumba and Sobson Glaciers (Himalaya): Mrs. F. B. Workman.

SOCIOLOGICAL SOCIETY, at 8.—The Origin and Function of Religion: A. E. Crawley.

TUESDAY, NOVEMBER 21.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Photographs of North American Indians: J. S. Chase.—Boomerangs: N. W. Thomas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Waterways in Great Britain (*Discussion*): J. A. Saner.

WEDNESDAY, NOVEMBER 22.

GEOLOGICAL SOCIETY, at 8.—On a New Specimen of the Chimæroid Fish *Myriacanthus paradoxus*, Ag., from the Lower Lias of Lyme Regis: Dr. A. Smith Woodward, F.R.S.—The Rocks of the Cataracts of the River Madeira, and the adjoining Portions of the Beni and Mamoré: Dr. J. W. Evans.—The Doncaster Earthquake of April 23, 1905: Dr. C. Davison.

SOCIETY OF ARTS, at 8.—The Cinematograph and its Applications: F. Martin-Duncan.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Nature of the Galvanotropic Irritability of Roots: Dr. A. J. Ewart and Miss Bayliss.—Some Observations on *Welwitschia mirabilis*, Hooker-f.: Prof. H. H. W. Pearson.—On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*; a Study in Relationship to the Causation of Malignant Disease: Prof. B. Moore, Dr. H. E. Roaf, and E. Whitley.—A Note on the Effect of Acid, Alkali, and Certain Indicators in Arresting or Otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*: E. Whitley.—On Certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics. A Contribution to the Chemistry of Anæsthesia. (Second Communication): Prof. B. Moore and Dr. H. E. Roaf.—(1) On the Possibility of Determining the Presence or Absence of Tubercular Infection by the Examination of a Patient's Blood or Tissue Fluids: (2) On Spontaneous Phagocytosis and on the Phagocytosis which is obtained with the Heated Serum of Patients who have responded to Tubercular Infection, or as the Case may be to the Inoculation of a Tubercle Vaccine: Dr. A. E. Wright and Staff-Surgeon S. T. Reid, R.N.—On the Occurrence of the Heterotypical Mitosis in Cancer: Dr. E. F. Bashford and J. A. Murray.

CONTENTS.

THURSDAY, NOVEMBER 23, 1905.

ZOOLOGY OF THE VERTEBRATA.

A Student's Text-book of Zoology. By Adam Sedgwick, M.A., F.R.S. Vol. ii. Pp. xv+705; illustrated. (London: Swan Sonnenschein and Co., Ltd.; New York: The Macmillan Company, 1905.) Price 21s.

THE first volume of this "Student's Text-book of Zoology" was published in 1898, and dealt with the invertebrate animals except echinoderms and arthropods. It was then hoped that another volume would suffice to complete the book, but that sanguine estimate was far off the mark. After half a dozen years the second volume has been completed, thicker than the first by a hundred pages, and the echinoderms, arthropods, enteropneusts, and tunicates are still to follow. A fourth volume will be required to deal with the principles of zoology. By that time the so-called student's text-book will require another title.

The first volume has a well deserved reputation for accuracy, clearness, terseness, and independence, and in the crowd of text-books it has filled a definite place to the satisfaction of teachers as well as of students. Presupposing a knowledge of "types," it dealt with the various classes in a systematic way, giving detailed classifications and taking account of a very large number of important forms. It was a successor of Claus's "Lehrbuch," but stronger in its grip, and vastly more interesting. The second volume is like unto the first, and it has been worth waiting for.

After a short introduction on Chordata, the author deals with the lancelets; then follows a discussion of the general characters of Craniata, and so on through the vertebrate series, each class, subclass, and order having its definition and general exposition followed by small print dealing with families and genera. The definitions are models of terseness; the large-print discussions of general characters are marvels of condensation and selective insight—almost peptonised extract of zoology—and the small print is monumental in its erudition. We took the last four vertebrates that happened to come into the laboratory—a water-shrew, a golden-crested wren, some young fierasfers, a specimen of Palæospondylus—and for three out of this fortuitous four we found interesting information in this encyclopædic volume. There is, however, another side to this relative exhaustiveness, that the details of classification are apt to change rapidly, and that many of the implied systematic conclusions must, from the nature of the case, have been simply accepted by the author because they were well vouched for by specialists. But there does not seem to be any way out of this except refraining from the very detailed treatment which is part of the characteristic aim of the book, or else adopting the cooperative device, which is apt to mean a lack of unity. It says much for the energy of the author that the classification of teleostean fishes is substantially that worked out by Mr. Boulenger, who supplied proofs of his work before its publication.

Leaving the question of the desirability of attempting so great exhaustiveness in what is at least called a student's text-book—a question which the gratefully recognised utility of the first volume has in part at least answered—we venture to express the hope that the final edition of the whole work will see some re-arrangement. Even unconsciously the student has what Herbert Spencer called an "architectonic" instinct; he likes some semblance of evolutionary order in his text-book. But although Mr. Sedgwick allows that enteropneusts and tunicates are chordates, they are not discussed in this volume, but must eventually be treated, we presume, at a remote distance, remote even from Amphioxus. Similarly, the annelids will be far away from the arthropods, and other instances might be given which suggest that the conditions of the production of this great work have not favoured its architectural plan.

Another carping criticism which we must make is this, that whereas the preface, like so many other prefaces, holds out the promise of "dealing fairly" with *habits* as well as with morphological aspects, we find after all that we have to be grateful for small mercies.

We confess also to some disappointment at the severity of Mr. Sedgwick's scientific mood, which may be illustrated, for instance, by this sentence:—

"As to its (the group Mammalia) origin in evolution we have nothing to say for the very good reason that there are no facts by which we can arrive at any conclusion on the subject."

(This does not, of course, refer to the affinities between Mammalia and other classes of vertebrates, which are briefly discussed.) Similarly, it is very difficult to discover what positive view, if any, the author holds in regard to the affiliation of Chordata to an antecedent stock. Incidentally, the author lifts just a little the veil with which he so successfully conceals his evolutionist convictions. Thus he says of the hag-fish:—

"To hold that a free-living animal, and a myxinoid must after all be regarded as such, can lose its eyes through disuse would seem to be an impossible position."

With such useful things to say the author might, to the advantage of his readers, have lifted the veil rather oftener. Criticisms like that of the story of the pedigree of horses are refreshing and salutary, and we regret to learn from the preface that the author has deleted a number of them. We look forward to the fourth volume to reveal more fully the author's scepticism "as to the value of some hypotheses widely held as to the course of organic evolution." It need hardly be said that Mr. Sedgwick is "a convinced evolutionist"; he also believes in the importance of natural selection, even in regard to non-living things; but "as to the origin of the manifold properties of living matter we know nothing. The Darwinian theory did not account for properties; it left their origin to an imperfectly understood interaction between the organism and the environment, and further than this we cannot at present go."

In referring to the construction which must follow criticism, Mr. Sedgwick says:—

"That is the task of the great band of workers in many departments of Biology, who, undeterred by failure and urged on by the fire, enthusiasm, and generous aspirations of youth, return time after time, generation after generation, to the assault of the fortresses of nature well knowing that their material reward will be small, that defeat means the world's neglect and that success, except the greatest, brings but a pittance of its esteem. To them I inscribe this book in the hope that it may serve if only to a small extent to smooth over the difficulties of part of the road which at first they have to travel."

We may be allowed to thank the author for doing more than "smooth over" the difficulties of the road on which all students of zoology have to travel, for he has cleared away many hindrances and pointed out many pitfalls. It would serve little purpose, however, to enter into any discussion of the numerous morphological problems in regard to which Mr. Sedgwick has made some personal and luminous contribution. We feel that we have not said enough in regard to the excellence of his workmanship, but praise of what is masterly is gratuitous. The book's scholarliness, clearness, and carefulness of statement are obvious, but those who work with it will discover other virtues—a suggestive scepticism, a mature judgment, and a more indefinable quality which we can only hint at in the phrase "morphological insight."

AN ESSAY IN HISTORICAL CHEMISTRY.

The Study of Chemical Composition: an Account of its Method and Historical Development. By Ida Freund. Pp. xvi+650. (Cambridge: The University Press.)

MISS FREUND is to be congratulated on having written a very interesting book. It is true that her subject-matter is to be found in many other quarters; she has really written a historical treatise on what is generally called stoichiometry; but having chosen as her title "The Study of Chemical Composition," she has left herself, so to speak, unfettered, and has been able to write somewhat more discursively than if she had compiled a treatise. Indeed, in the preface to the work she confesses:—

"Although anxious to trace separately the *historical development* in the discovery and in the establishment of certain laws and classes of phenomena, I have made no attempt to produce anything sufficiently complete or even sufficiently proportioned to deserve the name of *history*. I have preferred to deal in greater detail with a few researches, especially such as I could repeatedly utilise from various points of view, than to treat a greater number more cursorily, believing in what Lavoisier said more than a century ago that 'in such matters as these, the choice of proofs is more important than their number.'"

The result is a fairly full, indeed in some instances a very full, account of classical researches in the sphere to which she has confined her attention; the only omission is that of all reference to the laws of dilute solutions, and in this she was guided by the fact that the subject has been recently fully treated in many works which are easily accessible.

Beginning with a sketch of the method of the inductive sciences, quotations from Bacon, Jevons, Kant, Whewell, and Mill are introduced, with illustrations of deductive reasoning by Kepler, Lavoisier, Davy and others, having as its basis classification, generalisation, and law. Next follows a fairly detailed study of the phlogistic theory, giving an excellent summary of the views held by the phlogistonists. Here Cavendish's reasons for his choice of the terminology of the phlogistic theory might with advantage have been inserted. Examples of Lavoisier's and Stas's work, and of Morley's synthesis of water are given to illustrate the basis on which the doctrine of the "conservation of mass" is founded. But laws may be of two kinds, exact and approximate; the difference is illustrated by Boyle's law and van der Waals's improved form. We do not notice, however, the remark that van der Waals's formula itself is only a rough approximation to the expression of the behaviour of gases under high pressures. Landolt's experiments, which may be now accepted as a proof of the accuracy of the constancy of mass, are cited; the reviewer does not know if Landolt has published the fact that his doubts disappeared only after he had used silica instead of glass vessels.

Affinity is the subject of the next historical sketch; here the views of Bergmann and Berthollet are very well summarised; and this naturally leads to the conception of fixed ratios by Proust, and the succeeding work of Dalton and Berzelius, with reference to the ideas contended for by Laurent.

The author now harks back to theories of matter, taking up the subject at its earliest start in India and Greece. The speculations of Bacon, Descartes, Gassendi, and Boyle are described, generally in their own words. Next follows a full account of Dalton's atomic hypothesis, of Gay-Lussac's law of volumes, and of Avogadro's generalisation. Berzelius's attitude towards the rival views is explained, and a clear account is given of the veteran Cannizzaro's successful attempt to obtain full recognition of the justice of Avogadro's views, so long overlooked. The determination of atomic weight by means of specific heat, and an excellent account of Mitscherlich's work and its latest development by Retgers (this last, so far as the reviewer knows, has not previously been accessible except in original papers), complete this part of the subject. The periodic arrangement of the elements, and its bearing on the determination of atomic weights, leads naturally to a consideration of the doctrine of valency, and Miss Freund has not omitted to state the attempts which have been made to represent valency in terms of the electronic theory. A chapter on isomerism follows, and the concluding chapter treats of the constitution of matter and the genesis of the elements.

From this sketch it will be seen that Miss Freund has brought together, in a compact form, a great deal of interesting matter. She has quoted freely from the authors whose views she presents, and, on

the whole, with great judgment. The work is professedly a compilation, but it is a compilation by one who knows the subject. It would perhaps have been too much to expect that independent opinion on the many matters discussed should have been expressed, but we are at least put in possession of many views in an interesting and readable form. The work should be read by all advanced students of chemistry.

W. R.

THE KEW INDEX OF FLOWERING PLANTS.

Index Kewensis Plantarum Phanerogamarum; Supplementum Secundum, nomina et synonyma omnium generum et specierum ab initio anni MDCCCXCVI usque ad finem anni MDCCCC complectens. Ductu et consilio W. T. Thiselton-Dyer confecerunt herbarii horti regii botanici Kewensis curatores. Leucocoryne–Zygostates et emendanda addenda. Pp. 105–204. (Oxford: Clarendon Press, 1905.) Price *12s.* net.

THE second and concluding part of supplement ii. of the "Index Kewensis" follows quickly on the first. This means that we now have a list of the names and synonyms of genera and species of flowering plants published from the foundation of binominal nomenclature to the end of 1900—complete except for a serious gap in supplement i. representing the last third of the alphabet for the years 1886–1895. Three parts of the first supplement appeared between September, 1901, and November, 1903; the fourth is therefore much overdue. Its delay is the more to be regretted as the period with which it is concerned was one of considerable activity in systematic botany, including, for example, the great development of the Berlin school under Dr. Engler's direction. It is to be hoped that the completion of this portion of the work, for which Kew is not responsible, will soon be announced.

The best way to appreciate the Kew index is to call to mind the time before its appearance, when getting at the origin of a name meant often a long book-hunt, and sometimes a remarkable revelation of the wonderful and remote places in which it was possible to publish names, such, for instance, as the Melbourne *Chemist and Druggist*, in which, if we remember rightly, some species were published by the late Baron von Mueller. These literary researches were often extremely interesting, but they were not botany, and a failure by some botanists to realise their importance often caused worry and inconvenience to subsequent workers. In passing, we may note a feature of the index to which reference was made at the conference on nomenclature at Vienna last June. It was pointed out that the list of names of genera which a large majority of members agreed must be retained, even though they were not the earliest published names, departed very little from the names recognised in the index—it might even have been possible to have taken the index as a starting point.

The present number makes quite interesting reading, for it marks in a striking way the progress of systematic botany during the five years under consideration. Africa, especially tropical Africa, has afforded much material for work, as evidenced by parts of the Kew Floras, the catalogue of Dr. Welwitsch's Angolan plants, and other publications in this country; and the numerous papers on African botany issued from Berlin. The completion of the "Flora of British India" is chronicled by numerous citations in various genera of grasses; and there is also ample indication of the activity of North American botanists in working out their flora. Here and there is evidence of an important monograph, as that of Bromeliaceæ by Dr. Mez, or of Monimiaceæ by Miss Perkins, in a list of new species, combinations or reductions. Some entries under a quaint or unfamiliar name form a record of antiquarian research and love of priority; such, for instance, are those under Sitanion, a name of Rafinesque which antedates the well known Elymus; these names are promptly reduced to synonymy. It is, however, not always so easy to follow the reductions. For instance, American botanists seem generally agreed that Lewisia, a genus founded by Pursh, must be restored for certain species of Calandrinia; but the index quotes them only as synonyms, referring them back to Calandrinia. In looking down the columns one is struck by the large number of personal species-names, which seems to indicate a want of imagination on the part of some authors; thus nineteen out of forty-two new species of Polygala, and thirteen of twenty-two of Lissochilus, have names recalling the person who first collected or was in some way or other associated with the plant. A few omissions might be noted, though that has probably been done already by those concerned. A curious citation is given, under Peperomia and Panicum, of two species from Dr. Andrews's Christmas Island monograph.

In conclusion, we would express the hope that the record of the next five years, now nearly ended, may be available at as short an interval as possible.

A. B. R.

OUR BOOK SHELF.

Sugar and the Sugar Cane. By Noël Deerr. Pp. viii+395+xix. (Altrincham: Norman Rodger, 1905.) Price *7s. 6d.* net.

So many effects have already been ascribed by politicians and journalists to the Brussels Sugar Convention, that one hesitates to add to its account the recent large output of sugar-cane literature in this country, but there can be little doubt that the brighter prospects which the Convention seemed to promise sugar-cane planters has encouraged publication on this subject, and hence the issue, within the comparatively short space of three years, of four books, in English, dealing with the cultivation of the sugar cane or of the production of sugar therefrom.

There was, of course, much leeway to make up, since the interesting and important results achieved during recent years as the result of the cultural experiments carried on in British Guiana, the West Indies, Mauritius, Hawaii, Java, Queensland, India, and elsewhere were for the most part only available in the uninviting form of Government reports, and similarly there existed no general and concise account of the improvements recently brought about in the machinery used in sugar factories.

Mr. Deerr sets out with the object of "presenting in one consecutive whole a general view of the cane sugar industry," and it may be said at once that he achieves this object fairly successfully.

The arrangement of the volume coincides with the sequence of operations in the production of sugar, the earlier chapters dealing with such subjects as cane varieties, cultivation, influence of soil and climate, manuring and so on, and the later chapters with the harvesting of the cane, its transport to the factory, the extraction of the sugar, processes for the preparation of the commercial varieties of sugar, the disposal of molasses, the analysis of sugar products, and so on.

The objection might be made that some of these later chapters, notably those relating to the use of the polariscope, the estimation of "glucose," and the analysis of sugar-cane products are not sufficiently detailed to enable a novice to carry out the operations described, and yet are so full as to be tedious to anyone merely desirous of grasping the general principles upon which the processes are based.

The book will, however, be found useful by planters and sugar-estate managers who desire to be *au courant* with the progress made on the scientific side of their industry.

The volume is well illustrated—in this connection particular mention may be made of the coloured plates showing stems of some of the principal varieties of cane—and the text is remarkably free from errors, which is perhaps to be attributed to the fact that the book "was seen through the press" by the publisher, Mr. Norman Rodger.

My Strange Pets, and other Memories of Country Life. By R. Bell. Pp. vi+308. (Edinburgh: Blackwood and Sons, 1905.) Price 6s.

"IT is well known that the emu is a native of Australia, where on its vast plains they might have been seen in vast numbers" (p. 2). "The kick of an emu is a serious if not a dangerous one. . . . When sporting they spring up in the air, kicking sideways." Sentences like the above occurring close together at the beginning of a volume, and followed later by others of the same type, make one wonder whether the publishers or their printers keep a proof-reader on their establishments. But grammatical slips of this nature are not the only faults by which the work is disfigured, and the classically educated reader will scarcely fail to experience a severe mental shock when he finds the statement on p. 51 that "'lemur,' in the language of Madagascar, means 'night-wandering ghost.'"

Apart, however, from blemishes, Mr. Bell's book contains much interesting information with regard to the ways of many kinds of foreign creatures—from emus and rheas to jerboas and snakes—in confinement, accompanied by valuable hints as to the best manner of keeping them in health. The author, indeed, claims to have been the first to breed emus in Scotland, and it is perhaps a little characteristic of his nationality to find that the experiment undertaken for amusement turned out a financial success. The subject of foreign "pets" forms, however, only a portion of the volume, and the author records a number of more or less commonplace observations regarding the animals of his own country. As he appears to be an experienced angler, the statement of his disbelief in the theory that fresh-run salmon never habitually feed while in the rivers is worthy the best attention of the officials of the Scotch Salmon-Fishery Commission.

Throughout his life the author appears to have been specially interested in travelling menageries, and in a chapter on this subject he reproduces a long extract from the *Scotsman* of April 10, 1872, describing the sale of Wombwell's menagerie in that year. In this extract Wombwell is stated to have purchased the first rhinoceros and the first pair of giraffes ever imported into this country. As regards the former animal this statement is not strictly true, as witness the Indian rhinoceros described by Dr. Parsons in the early days of the Royal Society. If the statement with regard to giraffes be trustworthy, the fact has been generally overlooked by writers, George the Fourth's giraffe, received in 1827, and the four young animals obtained by the London Zoological Society in 1836, being generally regarded as the earliest importations. Wombwell's giraffes, it is stated, died before they were publicly exhibited. Although containing little that is absolutely new, the book is distinctly readable and entertaining. R. L.

Simple Lessons on Health for the Use of the Young. By Sir Michael Foster, K.C.B., M.P., &c. Pp. vii+114. (London: Macmillan and Co., Ltd.; New York: The Macmillan Company, 1905.) Price 1s.

MANY writers have tried their hands at the production of a small work which shall suitably present to a child's mind those elementary facts of healthy living which, as now generally recognised, should form an essential part of education; but it must be said that hitherto no one has wholly succeeded. Many have failed from an unnecessary elaboration of scientific detail, and others from a faulty presentation of the subject-matter.

Sir Michael Foster's manual makes no pretence at covering the whole of the necessary ground. He makes it clear in the preface that his object is to show how the reasons for *some* of the rules which ought to guide us in the physical conduct of life may be explained even to the very young. The subjects dealt with are:—fresh air, food and drink, light and cleanliness. The physiological basis of certain health principles could not be more happily expressed; but as to how the individual can best meet his hygienic needs in his daily life and circumstance the writer has little—far too little—to say. With this reservation it may be said that Sir Michael Foster's little book is a model of what simple lessons on health to the young should be, and that, as an illustration of how these matters should be presented to young children, it is unequalled by any other book with which we are acquainted. For this reason, if for no other, all those who are likely to have the important duty cast upon them of instructing the young on these vital matters should carefully study its simple, clear, and wholly satisfactory method of treatment.

Actualités scientifiques. By Max de Nansouty. Pp. 365. (Paris: Schleicher Frères, 1905.) Price 3.50 francs.

SUCH a collection of short readings in French as is here provided will prove of service to young students of science who are either learning French or are desirous of keeping up their knowledge of the language by reading which will not take them far from their serious work in science. There are eighty-four popular essays, each of three or four pages, divided into seven groups dealing respectively with physics and chemistry, astronomy and meteorology, electricity and its applications, agriculture, hygiene, psychology and physiology, and applied sciences.

The volume may appeal to a few general readers interested in popular accounts of progress in pure and applied science There are no illustrations.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The British Association and our Colonies.

THAT four hundred members of the British Association have recently visited the principal places of interest in South Africa, that they have been the recipients of magnificent hospitalities, that they have read papers and discussed points of importance bearing upon the development of African colonies, are facts well known to the reading public. Although so much has been written and said about what the association has done, but little has been conjectured as to possible outcomes from this remarkable excursion. To many the expedition may appear as a gigantic "picnic," the members participating in which have had a hurried glance at Africa and have returned with that modicum of knowledge which is proverbially regarded as dangerous. If, however, we turn to a list of the names of those who were members of the association party, and observe that it includes those of recognised leaders in science, literature, and in a variety of professions, casual conclusions of this nature are at once dispelled. What is realised instead is that South Africa has been visited by a number of specialists whose services are frequently retained by Governments and corporate bodies. No doubt these gentlemen have learned much, but it is difficult to imagine that they left South Africa without leaving some small return. Now that they are back in Britain it is tolerably certain that they have brought with them opinions bearing upon railways, mines, agriculture, emigration, and on other matters connected with the development of South Africa, all of which will command attention. A well known eastern country which sends its experts to exploit the western world attains a similar end by systematised departmental methods.

The benefits of greatest importance, however, may be the resultant of personal and friendly relationships which have been established between leading men of science and practical workers in two related countries. These relationships should stimulate reciprocity, remove misconceptions, and pave the way to cooperation in various directions. Regarded from this point of view, it is difficult to escape from the conclusion that the meeting of the British Association in South Africa has played an important part in strengthening a union between a parent and its offspring.

Should views of this description meet favour, it remains for members of the British Association and others to consider the possibility of extending the work of such national importance. One method by which this might be attained would be the organisation of an intercolonial meeting of the British Association. The difficulties connected with the organisation of such a convention, say in London, to be supplemented by visits to various centres in Britain, to which representatives and visitors from oversea connections should be invited, have already been informally discussed by home and colonial members of the British Association. They do not appear to be insuperable, and it may be anticipated that such an undertaking would meet with national approval and support.

JOHN MILNE.

The Stone Age of the Zambesi Valley, and its Relation in Time.

ABOVE and below the Victoria Falls stone implements are present in profusion, both in the river gravels on the highest margins of the Zambesi valley and also spread broadcast, along with rolled gravel, on the basalt platforms of the ancient river channel below the Victoria Falls. Stone implements are also found in abundance along the highest banks of the Zambesi below the present falls, at the junction of the "desert sands" and the underlying basalts. (I use the term "desert sands," for, though its surfaces are now wooded, it has been deposited under Æolian desert conditions.) At the base of these "desert sands," which form the highest margin of the old Zambesi valley below the present falls, and resting immediately on the basalt platform, are horizontal beds of chalcedony, ferruginous sandstone, and quartzite sandstone; these are certainly the products, and have been formed at the base of the "desert sands."

These "desert sands," which occur on both sides of the Zambesi valley, I was able to examine for some distance below the Victoria Falls. They are of considerable thickness, at places fifty, sixty, and perhaps a hundred feet in depth. The railway from the falls to Bulawayo passes through these sands, and good sections are to be met with. There are no stone implements, pebbles, or stone of any description to be found throughout their entire structure until we reach the very bottom, where the horizontal beds of chalcedony, ferruginous sandstone, &c., rest *in situ* on the basalts. The chalcedony layer varies in thickness from a few inches to two feet or more. I may here remark that the majority of the implements are made of chalcedony; likewise to a great extent are the pebbly gravels of the river, both above and below the Victoria Falls. Of the thousands of implements and rolled pebbles that I handled, very few were made of any other substance but the rocks that lie at the base of the "desert sands," and I did not find a single implement made of basalt or dolerite. The quarries of the prehistoric men were the beds that lie at the base of the "desert sands," and when they were fashioning their implements along the horizon of the chalcedony formation there can be no doubt that the Zambesi was flowing at their feet, a smooth and noble stream, precisely as it flows now through the "desert sands" above the present falls, and the basalt and dolerite platforms were sunk under the waters of the river.

The evidences that the river gravels and included implements now resting upon the basalt platforms below the Victoria Falls were deposited by the Zambesi when it flowed at a height of 400 feet or 500 feet above its present level are as follows:—Above the Victoria Falls, on the left bank of the river, near the ferry to Livingstone Island, the river gravels are well in evidence. They consist of rounded pebbles of chalcedony, quartzites, and various other rocks; the contained implements are more or less water-worn, and of the same character as those in the gravels below the Victoria Falls. I took from this horizon implements of Palæolithic type.

When we pass below the Victoria Falls to the Rain Forest, we can realise without doubt that the Zambesi once flowed over this area, and that its southern cliff must once have been the falls of the river. In the water-worn gullies of the Rain Forest implements and rounded pebbles are to be found of the same character as those in the beds above the Victoria Falls; they must have been deposited there by the river when the Rain Forest area formed part of its bed. When we travel further down the course of the old river-bed we find on the platforms and promontories of the basalt, now eroded by deep lateral ravines, which overlook the zigzags of the cañon, where the Zambesi rushes 400 feet below, deposits of implement-bearing gravel. We cannot therefore escape from the conclusion that these implements and pebbles were deposited there by the Zambesi when it flowed over these surfaces prior to the excavation of the chasm. From these surfaces I took implements some of which, if found in Europe, would be called typical Palæolithic types.

If I am correct in my observations as to the method of deposition of these implements, we may be satisfied that an immense period of time has elapsed since Palæolithic man lived on the banks of the Zambesi. We cannot at present measure that period by our chronological record, but we may be satisfied that man lived there when the Zambesi below the Victoria Falls flowed 500 feet above its present level, and before its waters had carved out through hard basaltic beds the wonderful chasm that now extends for forty miles below the Victoria Falls. Perhaps geologists may in the future be able to arrive at some trustworthy conclusions as to the rate of retrocession of the falls of the Zambesi, and the carving out of its chasm, which would give a more or less accurate determination of the period when primæval man occupied the Zambesi valley. At present we can only say that a great lapse of time must have occurred; but this deduction, being based

on recognisable geological factors, namely, the wearing out of the chasm of the Zambesi and the retrocession of its falls, we have an advance in our positive knowledge as to the remote age of the Palæolithic stone implement beds of South Africa. H. W. FEILDEN.

Terminology in Electrophysiology.

TAKING the diagram given by Dr. Fraser Harris (p. 5), all writers will agree with him that A is positive plate and negative pole, and I believe that the use of the word "zincative" has gone some way to promoting this agreement.

Dr. Harris goes on to say that no loophole for confusion could be left if the qualifying words *externally* or *internally* were added, by stating, *e.g.*, that A is internally electropositive to B and externally electronegative to B.

I find three objections to this suggested clarification:—

(1) The expressions thus qualified are cumbrous, and must infallibly become abbreviated in current language by omission of the qualifying words.

(2) The expression "externally electronegative" contradicts the conventional use of the word "electronegative" which is attached to the plate and not to the pole.

(3) There is no provision for the complementary qualification to denote that a tissue is capable of being aroused to electromotive action, *i.e.* capable of being rendered zincative, *i.e.* zincable.

I freely admit that this convenient jargon offends the ear while arousing the understanding. I will gladly bury the words "zincative" and "zincable" when they have fully served their purpose as danger-signals that confusion is possible; but until we have agreed that active tissue shall be called "externally or galvanometrically negative" or "internally electropositive" I do not think loopholes for confusion have been closed. I should be satisfied with the old external word "negative" if it did not involve the conception of an internal "propagation of a wave of negativity," and the occasional misstatement that a wave of electronegativity is propagated through nerve and muscle. I should be glad to say that A is electropositive to B if I were not convinced that the prefix "electro" would be occasionally dropped to the further confusion of the reader accustomed to be told that A was (externally) negative.

So that, *en attendant mieux*, in order that there may be no confusion as to my own meaning that A is externally negative and internally positive, I say that A is like zinc or zincative. The parable, if there be parable, is intended to point out and avoid a confusion, but there appears to be an unfortunate tendency to confuse an indication of confusion with an introduction of confusion.

The physicist does not help us much. When he has appreciated the ambiguity of our physiological language, which is of physical origin, he supposes it to be no more than another case of the ambiguity familiar to us in the naming of accumulator poles, where, in order to avoid the perplexities that would arise from calling the same plate positive during charge and negative during discharge, the convention has become accepted always to call positive the plate that is connected with the positive pole of the charging battery or dynamo.

Our trouble is that there is among physiologists no accepted clear convention analogous with this convenient custom of miscalling the positive plate of an accumulator in a perfectly intelligible manner. Therefore again, when it seems particularly desirable to indicate seat of activity and direction of current internally as well as externally I still say "*zincative*" in order that there may be no mistake of meaning. A. D. WALLER.

BOTH Dr. Harris (p. 5) and Prof. MacDonald (p. 28) somewhat misrepresent the use by physicists of the signs + and −. As applied to a closed circuit they are purely relative, each point being simultaneously positive to all points on one side of it and negative to all those on the other. The confusion arises from the fact that terms belonging properly to electrostatics were adopted long ago in describing the phenomena of the galvanic battery.

It is impossible to define direction in a circle—or any closed circuit—with less than four points—one lying in a different plane from the other three. In a circle drawn on paper, one of these is given, namely, the position of the observer behind or in front of the paper. If we put two others on the circle there is still ambiguity, for we may go from + to − in either direction, as in the armature coils of a dynamo; but with the use of three symbols the ambiguity vanishes. Thus *abc, bca, cab* indicate one direction, and *cba, acb, bac* indicate the other. As with formulæ containing an asymmetric carbon, the enantiomorph is given by turning the diagram over.

In diagrams of electric circuits some portion of the apparatus, either the source of E.M.F. or the place where it is being used, is tacitly taken as the third symbol, and the signs + and − put on either side of it to indicate which way the current flows. Dr. Waller's word "zincative," to anyone who knows how zinc behaves, indicates without possibility of error the direction of the current across the region that generates it, and the electrically-minded student may trace its course thence by arrows, remembering that while the circuit is closed the tail of each arrow is positive to its head, but directly the circuit is broken the whole of the side that ends with a head is positive to the whole of the side that ends with a tail.

To the physicist the terminology formerly used by physiologists was most confusing—in my own case it conveyed an entirely wrong impression until I had made an experiment with my own hands. It is most desirable that the anomaly should be removed, and in my opinion it may best be done by dropping the unsuitable terms positive and negative, and saying either that current flows from the more active to the less active part of a tissue or that the one is zincative to the other. GEORGE J. BURCH.

University College, Reading, November 11.

Action of Radium Salts on Gelatin.

ON continuing the experiments detailed in NATURE of October 26, I found that lead and strontium salts produced the same results upon gelatin as was the case with radium, but the strontium "growths" were much less vigorous than the others.

On considering the results, it is seen that the metals named are those which form insoluble sulphates, and it occurred to the writer that the "growths" were simply a precipitate of some insoluble body formed by the action of the salts used upon the gelatin.

Various solutions of bouillon and gelatin were prepared, and to each were added a few drops of solution of radium or barium or lead salts, with the result that in each case a precipitate was obtained which on careful examination was found to consist of a sulphate, or at all events an insoluble compound, containing sulphur.

The precipitate produced by the radium salt was tested to see whether it was in any way different from that produced by the barium salt, but, with the exception that it was radio-active, it appeared to be similar in all respects. It was insoluble in strong acids, and gave a sulphide on fusion with sodium carbonate on charcoal, and qualitatively contained no other metal than barium.

In making the experiments, a few drops of the gelatin were placed on a glass slide, and particles of radium and barium salts added as described in the last communication. The "growths" appeared. Some solution of barium nitrate or radium salt was now added to the liquefied jelly. The usual precipitate appeared, and this was filtered off through a porous tube. The clear jelly was now tested with radium and other salts, and no growth could be seen even after seven days.

I think this proves very conclusively what the alleged "growths" are, viz. that they are nothing more than finely divided precipitates of insoluble barium salts. I have examined these precipitates with the highest microscopic power at my disposal, and cannot, in any case, perceive that there is anything of the nature of cell division occurring.

Of course, many pairs of particles may be found, but the grouping must be purely fortuitous.

As there is only a limited amount of matter in the gelatin which can be precipitated by the radium, a concentration occurs at the point of contact of the salt with

the gelatin, and then a slow diffusion of the remaining salt takes place downwards, and this might give rise to the idea that the thing was really growing.

W. A. DOUGLAS RUDGE.

Woodbridge School, Suffolk.

The Spectrum of the Positive Rays (Canal-Strahlen).

IN former publications (*Ann. d. Phys.*, vol. xiv., p. 524, 1904; vol. xvi., p. 490, 1905; "Die Elektrizität in Gasen," Leipzig, 1902, pp. 446, 457) I have expressed the opinion that the carrier of the line spectrum of a chemical element is the positive atom-ion, while, on the other hand, the band spectrum is due to the re-combination of positive atom-ions with negative electrons. From this it would follow that the particles of the positive rays (being positive atom-ions) should emit the line spectrum of the gas in which they are produced. Moreover, since these particles possess a considerable velocity, their spectrum lines, observed in the direction of the rays, should have a position and breadth differing from the position and breadth when the lines are observed in a direction normal to the rays. Again, since the positive rays ionise the gas traversed by them, re-combination of positive and negative ions must take place in their path; the gas traversed by the positive rays must therefore emit the band spectrum, which will be superposed on the line spectrum due to the positive rays themselves. The lines of the band spectrum must have the same position whether they are observed in the direction of the positive rays or in a direction at right angles to them, inasmuch as their carriers do not possess the velocity of the positive rays.

I now state briefly the results of an experimental spectrographic examination of the light emitted by a gas traversed by positive rays. (1) Nitrogen shows simultaneously the band and the line spectrum, hydrogen shows simultaneously the series spectrum ($H\alpha$, $H\beta$, . .) and the many lines spectrum. (2) The line spectrum emitted normally to the positive rays and the line spectrum emitted in the direction of the rays are different; the former shows in hydrogen sharp lines of the known wave-length, while the latter shows these "stationary" lines, and besides them, on their ultra-violet side, new widened lines ("displaced" lines). (3) This displacement is greater when the velocity of the positive rays is greater. (4) The lines of the band spectrum (many lines spectrum) have the same position and breadth whether they are observed in the direction of the positive rays or in a direction at right angles to them. A full account of the investigation will be published shortly.

Göttingen, November 3. J. STARK.

Replicas of Diffraction Gratings.

KINDLY allow me to correct a statement contained in your notice of Mr. R. J. Wallace's replicas of diffraction gratings in your issue of November 2 (vol. lxxiii. p. 21).

It is there stated, as also in the *Astrophysical Journal* from which the extract was taken, that I first flood the grating with oil in my method of producing replicas. This I may say I have never done except when making experiments, my procedure being exactly the same as Mr. Wallace's, viz. to flood the grating direct with the clarified celluloid solution, dry it in much the same way, but using special precautions to ensure perfectly even drying, stripping and mounting in a similar manner to Mr. Wallace, but leaving out the gelatin coating, which in my opinion is quite unnecessary.

I beg to enclose you one of Mr. Wallace's first quality (average) replicas, kindly sent to me by him in exchange for one of my own, as also a couple of mine for comparison. The great difference to be noted in their surfaces and performance is due to the peculiarities in the surfaces of the original gratings, one of my own replicas having a brightness in the first spectrum on one side of at least four times that of the other, and twice that of Mr. Wallace's replica.

The grating from which the very bright replica is taken is a "Rowland" of 14,438 lines to the inch, and was formerly the property of the late Dr. Common. The original of the other is a very beautiful specimen of recent work on the Rowland engine, 15,038 lines to the inch. Now, whilst the latter when mounted on parallel plane glass gives comparatively feeble spectra, when mounted on prisms for direct-vision purposes, and tilting the prism to the angle required for the minimum deviation for the diffraction spectrum, first order, the brightness approaches that from the "Common" grating, whilst its much greater freedom from scattered light renders it very suitable for prominence and similar work, the dispersion being about equal to five 60° flint glass prisms in the centre of the spectrum, and decidedly greater at the red end.

This increase of brightness is, of course, attributable to the form of the grooves, less interference being produced under the latter condition, and this notwithstanding the increase in dispersion.

It may be of interest to some to know that I have succeeded in mounting these grating films on a perfectly flattened ring of glass, so that, by avoiding the use of glass as a base, light of very short wave-length can be examined by this means, either in the one case by transmission to about λ 2600 or by reflection to as low as λ 1850, and possibly lower. (The discovery of this reflective property for ultra-violet light was made by Mr. Morris-Airey, of the Victoria University, last year.) In order to examine by reflection either a partial vacuum is created behind the film when mounted on a glass ring or the film is mounted on a concave surface, which, although not giving the lines of the grating their true form, gives very fair resolution.

I have also succeeded in making concave replicas practically as perfect as plane ones, by rotating the grating during the drying process at such a rate that the paraboloidal curvature of the solution was practically the same as that of the grating. Anyway, the difference is so slight that when dry no rings can be seen on examining it by monochromatic light before the film is stripped from the grating. The difficulty of silvering these replicas satisfactorily has, however, prevented further progress, for the present at least.

In justice to Mr. Wallace I ought to say that, in a reply to a letter from me, he states he obtained his information from a patent I once took out in connection with the application of these grating replicas to colour photography; but the method there described is not the one I have adopted in making my replicas.

THOMAS THORP.

Whitefield, near Manchester, November 6.

THE article referred to by Mr. Thorp was, as mentioned in its first two lines, simply a *résumé* of Mr. Wallace's article in the *Astrophysical Journal*; and the statement corrected by Mr. Thorp was taken from that journal. It may be said, however, that the three gratings sent by Mr. Thorp have been compared, under similar conditions, and the results are in full accordance with the descriptions given above.

The second "Thorp" replica (15,120 lines) is a beautiful specimen in appearance, having none of the mottling which appears on the 14,438-line copy, but its first-order spectra are excelled in brightness by the first-order spectrum on one side of the latter, which is a similar replica to those that have produced such remarkably good results in eclipse and other observations when attached to just an ordinary hand-camera or a simple modification thereof.

THE WRITER OF THE NOTICE.

Aurora of November 15.

AN extraordinary aurora was seen here on November 15 at 6 p.m., in appearance something like a "stormy" sunset. The lower part of the aurora was illumined with a bluish-green light, and had an altitude at the centre of about 10°. Above this, extending for a further ten or fifteen degrees, the sky was brilliantly illuminated with streamers of a rosy red colour. I did not wait for its disappearance, but at 9.30 p.m. red streamers were visible in the N.N.W.

I looked for the Leonids this morning continuously from 1.20 to 2.35 from the vantage ground of the Dartmoor hills (1500 feet). I saw only one Leonid at 2.30, but the moon would prevent small ones being seen. The night was perfectly clear. ROWLAND A. EARP.

Buckfastleigh, S. Devon, November 16.

TRAVELLING this evening between Plymouth and Exeter, I pulled the screens over the light in my compartment to enjoy the moonlight, and was rewarded by seeing a fine display of aurora borealis, which was, I hope, witnessed by some other of your readers.

Between 9 p.m. and 9.30 p.m., when near Totnes, there was a bright flattened arch near the northern horizon, with white streamers rising from it at intervals, and very bright patches of rose-red, extending from north-east to north-west, and passing nearly overhead. At 9.15 one of these patches, on the right of the Great Bear, was a veritable "pillar of flame," and was more remarkable because of its contrast to the moonlight, which was very brilliant.

I think I am right in saying that a similar display has not been seen in the south of England for twenty-five or thirty years, and the last "rose-red" display that I can remember was in 1870. R. LANGTON COLE.

November 15.

A LUNAR THEORY FROM OBSERVATION.

ON June 3, visitation day at the Royal Observatory, Greenwich, the editor, who is a member of the board of visitors, asked me to write an account of my researches on the moon for NATURE. I delayed doing this for a few months in order to render my account more complete.

The moon's longitude contains about 150, and the latitude about 100, inequalities over $0''.1$. The arguments of these inequalities, and the mean longitude of the moon, require a knowledge of three angles connected with the moon, viz. the moon's mean longitude, the mean longitude of perigee, and the mean longitude of the node. The other angles involved in the arguments define the position of the sun, planets, the solar perigee, &c., and their values are to be determined from other observations than those of the moon.

The problem that I have had in view, therefore, is to determine the values of three angles as functions of the time, and to give a list of some 250 inequalities in all as accurately as possible.

Before the time of Newton, this was clearly the only way the problem of the moon's motion could be attacked, only the limit worked to was then more nearly $500''$ than $0''.1$. Since the time of Newton, the method has been almost entirely abandoned. Many mathematicians have attempted to calculate how the moon ought to move; the comparison between its observed and theoretical course has been rough in the extreme. No attempt has been made to verify from observation the coefficients of those inequalities for which a theoretical value had been calculated; observation has merely been required to furnish values for those constants which are theoretically arbitrary, and, as I shall show, the determination of these constants has often been rendered less accurate than was necessary by the tacit assumption that all theoretical terms had been accurately computed.

My point of view, as I have said, is that which was necessarily the only one before the time of Newton. Let us consider the application of this most ancient of all methods to the time when no observations were possible except a record of eclipses.

The two principal inequalities of the moon's longitude are

$$22640'' \sin g + 4586'' \sin (2D - g),$$

where g is the mean anomaly and D the mean elongation of the moon. Whenever the moon is either new or full, $2D = 0$; at such times, therefore, the two inequalities are indistinguishable from a single inequality

$$22640'' - 4586'' = 18054'' \sin g.$$

The "evection," as the smaller inequality is called, could evidently not have been discovered until the moon was observed near its quarters; moreover, a correct value of the eccentricity of the moon's orbit could never have then been obtained. On the other hand, so long as the sole object of astronomers was to obtain places of the new and full moons it did not matter whether the two inequalities were separated or not. Roughly speaking, material of a limited class is always good enough for generalisations confined to the same class; it is unsafe to extend the generalisation to a wider class, as in this instance it would be wrong to predict for the quarters of the moon from the formula $18054'' \sin g$.

When we have an extended series of observations and wish to determine whether a term $x \sin \alpha t$ runs through the errors, and, if so, to determine x, the theory of least squares directs us to multiply each error by $\sin \alpha t$ and add. But before equating

$$x\Sigma \sin^2 \alpha t = \Sigma \epsilon \sin \alpha t$$

we must pause and consider whether there may not be some other error $y \sin \beta t$ running through the observations such that

$$y\Sigma \sin \alpha t \sin \beta t \text{ is not zero.}$$

Now an interfering term of this sort may arise in two ways:—(1) β may differ so little from α that throughout the whole series of observations the difference between αt and βt does not take indiscriminately all values from $0°$ to $360°$; (2) the difference between αt and βt may be exactly equal to the mean elongation of the moon, in which case, since the observations are not uniformly distributed round the month, the two inequalities are liable to be confounded, just as the elliptic inequality and the evection were confounded in the early days of astronomy. Interference of the first kind can be eliminated by sufficiently extending the series of observations, but no amount of observations will obtain a correct result in the second case if the mathematical point is overlooked.

As a result of attending carefully to these considerations, I have succeeded in obtaining practically the same value of the eccentricity of the moon's orbit from two different series of observations compared with two different systems of tabular places. Hansen and Airy have given values of the same quantity differing by more than one second of arc. For the same reason, the value of the parallactic inequality of the moon obtained by me corresponds closely with the value of the solar parallax obtained in other ways. The consideration neglected by Airy in this case was the possibility of error in the tabular semi-diameter.

I have determined from the observations the coefficient of every term the coefficient of which was known to exceed $0''.1$. This constitutes, as I have said, the solution of the problem of the moon, as it presented itself before the time of Newton. It forms, too, the proper basis for comparing observation with theory. Previously the only thing known about the vast majority of terms was that whereas the apparent errors of Airy's tabular places frequently exceeded $20''$, those of Hansen's seldom differed from the mean of neighbouring observations by so much as $5''$, a quantity that might be attributed to errors of observation entirely. When, however, Newcomb in 1876 came to re-determine the value of the moon's eccentricity (in his immediate object he was not particularly successful owing to the neglect of the considerations I have just set down), he brought to light a term the coefficient of which is one second, and the argument of which was at the time unknown. The discovery of this term shows how unsafe it is to test the tables by the mere inspection of the series of errors of individual observations. However, in all my far more

exhaustive search I only brought to light one fresh inequality that runs through the errors, and that is to all appearance due to an error in the adopted parallax of the moon. My analysis, however, enables me to say that the solution of the problem of three bodies, as recently completed by E. W. Brown, is final. This might fairly be inferred from its agreement with Hansen and Delaunay, and from the numerous equations of verification employed throughout by Brown. But on my analysis a further remark may be based; not only are Brown's expressions a correct solution of his differential equations, but those differential equations do really represent, with all necessary accuracy, the problem of three bodies as presented by nature. The problem has been solved. If in the future a method as much superior to Hill's as Hill's is to Hansen's were to be invented, it would no doubt be worked out numerically, but no matter how ingenious it might be, the test of its accuracy would be—does it agree with Brown?

Another inference may be drawn from what I may call my empirical lunar theory. As the coefficients of solar terms are verified by Brown's calculations with a probable error of about 0″·04, that is presumably a measure of the accuracy of the constants. Moreover, on comparing the planetary and figure of earth terms with theory, larger discordances are found, especially in the figure of earth terms and in the Jupiter evection term. There is no special difficulty in obtaining these terms from observation; they are presumably determined as accurately as the others. Consequently, appreciable errors still exist in the theoretical values of the figure of earth terms and the Jupiter evection term.

Two suppositions of Hansen's on which he founded alterations of his tables have also been disproved, a mechanical ellipticity of the moon and an eccentricity in the face that it exhibits to the earth.

I come now to another class of investigations. The theory of the moon is deficient in that it does not explain the cause of a term of period of about 300 years and coefficient 15″ which observation shows to exist. This deficiency of theory is an inconvenience in many ways. It renders the determination of the secular acceleration of the moon, and the resulting measurement of tidal retardation, impossible from modern observations. It will be years, possibly two centuries, before from observation alone a really accurate estimate of the missing term can be given, unless, as is much to be hoped, theory accounts for it in the meanwhile. This unknown term renders difficult also the determination of the motion of the node and perigee. The position of the perigee is found by measuring an arc equal to the mean anomaly back from the mean position of the moon, and it is fairly clear that the unknown term is also an inequality of the anomaly. Hence the motion of the anomaly contains a periodic part that it is difficult to allow for accurately. I have determined the motion of the node and perigee over a period of 150 years, and I get small differences from the theoretical values recently published by Brown. Possibly the cause that produces the term of long period also produces a small motion of the node and perigee. Hansen assumed an empirical term of 240 years' period for this unknown term, but before Hansen's tables had been in the Nautical Almanac for twenty years, Newcomb found it necessary to change the period assumed to 273 years. Each assumption was associated with an argument in the hope that it would turn out to be the correct argument, but both in turn have been disproved. My own idea as to the term is that its period is more nearly 350 years, and I have no suggestions to make as to its argument. There are also smaller terms of 40 and 70 years' period approximately, or possibly the errors assume a more complicated form still. The periods are so long that the uncertainty is great.

The last section of my investigations deals with the ancient solar eclipses and the value of the secular accelerations. The three angles mentioned at the outset of this paper as requiring measurement contain terms proportional to the square of the time. It is evident that these terms become of considerable importance at remote epochs. Also on their accurate determination depend (1) the degree of assistance that astronomy can extend to chronologists; (2) a numerical estimate of the tidal retardation of the earth's diurnal rotation.

I have succeeded in showing that the alteration of two of the secular terms renders total, or at any rate central, five ancient eclipses which are partial according to the existing tables. This may, of course, be an extraordinary coincidence, but it seems more natural to suppose that records of the eclipses have come down to us because they really were striking phenomena worth recording—in one case the account says "fire in the midst of heaven," which seems to indicate the corona, and therefore totality. There is also the further fact in favour of these corrections that one of them is confirmed and the other supported by the ancient lunar eclipses. It may be of interest to mention that the most ancient eclipse of the five was communicated to me from the British Museum after I had deduced corrections from the other four, and that the corrections already found satisfied the condition of totality for the newly discovered eclipse. To such an extraordinary piece of luck the words of Virgil seem applicable:—

> "Turne, quod optanti divom promittere nemo
> Auderet, volvenda dies en attulit ultro."

It had occurred to me to wonder whether it was worth while to write to the British Museum, but the chance seemed so small that I was letting the days slip by without doing so.

Ancient eclipses, therefore, give an accurate measure of the relative distances of three points, the positions of the node, the sun, and the moon. The next question is, "Where is the equinox relatively to these three points?" My first interpretation of my results proceeded thus:—The position of the sun relatively to the equinox has never been called in question. We may be assumed to know it. Therefore my calculations determine the distance of the node from the equinox. This view of the matter, I now am glad to say, was found on examination to be untenable. In the words of Dante, what I spun in October did not last until the middle of November (the date of the first meeting of the Royal Astronomical Society):—

> "a mezzo novembre
> non giunge quel che tu d'ottobre fili."
> Purg., vi., 143.

The position of the node, in fact, may be inferred with certainty from the gravitational calculations of Prof. Brown. Hence my eclipse results determine the position of the sun as well as of the moon. The conclusion is that the sun's motion is being accelerated.

The most obvious hypothesis to account for this observed fact—it does not follow that it is the only hypothesis—is that the æther has a sensible retarding effect. It may seem curious that the resistance of the æther should accelerate the earth's orbital motion, but that undoubtedly would be the effect. The total energy must be diminished, and this implies that the planet falls in towards the sun and consequently revolves faster in its orbit. P. H. Cowell.

SCIENCE AND ART OF CRICKET.

THE golfing world already owes a debt of gratitude to Mr. Beldam for his "Great Golfers." This companion volume, setting forth on the same lines the styles of play of our greatest cricketers, cannot fail to appeal strongly to all lovers of the most English of our national games. The method adopted here is identical with that of the earlier book. Each of the many batsmen pictured has been photographed in one or more characteristic attitudes before, during, or after the striking of the ball, and after a careful study of every picture Mr. Fry has set down his own interpretation for the guidance of the reader. No better guide could have been got, for among the great cricketers of our day Mr. Fry stands conspicuous as one who has studied the art of cricket with phenomenal success.

The book is divided into two parts. In part i. (individualities) close on 300 photographs are given of eighteen of our best known batsmen, including Grace, Ranjitsinhji, Trumper, Fry, Hill, Jackson, Duff, MacLaren, and so on. In part ii. (strokes illustrated) the various kinds of recognised strokes are systematically discussed and illustrated by photographs of other great batsmen. There is, of course, a good deal of repetition of the same ideas in the letterpress of these two parts, but each has its own value. In the one case it is the individual batsman whose pose and actions are being studied; in the other it is the kind of stroke which is the object of discussion, and this is helped out by an appeal to the example of a number of different cricketers. The volume ends with a short but very practical and interesting chapter upon the art of timing with the camera. We learn that the operator sometimes used a finger release of the shutter and sometimes an electric. The latter method enabled Mr. Beldam to act, in same cases, both as bowler and photographer. The requisites for good work of this kind are complete knowledge of the mechanism and capabilities of the camera, thorough acquaintance with the game itself, and a delicacy of judgment which must be partly inborn and strongly developed by practice. We are not told what proportion of photographs taken were failures, but the beauty and clearness of the 600 here shown prove that Mr. Beldam is a master hand in the art of taking action-photographs.

Where almost every picture is admirable, and illustrates some essential part of a particular stroke, it is not possible to choose for reproduction any that might be regarded as representative. W. G. Grace, for example, is shown in twenty-six different attitudes, and all have some lesson to tell. In the photograph reproduced we have the finish of an on-drive, in which the turn of the body has aided powerfully in giving full effect to the stroke. The eyes are still looking at the spot where the ball was when it was struck. The whole series of photographs proves that all great batsmen follow the ball with their eye right up to the moment of striking. It is this which gives precision, just as in golf.

FIG. 1.—W. G. Grace—Finish of an On-drive.

Ranjitsinhji is figured in twenty photographs, and it is in the comparison of these with the attitudes of other cricketers that the limitations of the method of

[1] "Great Batsmen, their Methods at a Glance." By G. W. Beldam and C. B. Fry. Pp. xiv+716: illustrated by 600 Action-photographs. (London: Macmillan and Co., Ltd., 1905.) Price 21s. net.

instantaneous photography appear. Except in a few cases there is no appreciable difference between his attitudes and those of others; the characteristic style of Ranjitsinhji depends upon the rapidity of the successive movements which go to make the complete stroke, and this is necessarily lost in the momentary picture. One very characteristic poise of body is given in the eighteenth of the series of pictures of the Indian cricketer. Here we have the finish of the well known leg-glance. To quote from Mr. Fry's description:—"the unique part of the stroke is the foot work . . . the left foot is moved across right in front of the wicket, passing immediately across the right. The body from the hips upwards is twisted round towards the leg-side. The bat, at the instant it meets the ball, is perfectly upright just in front of the left knee. Playing this stroke in this way would be impossible for anyone less supple and less quick than Ranjitsinhji."

FIG. 2.—K. S Ranjitsinhji—Finish of the Leg-glance.

This is not the place for discussing in any detail the many different kinds of strokes recognised in cricket, though a good deal might be spoken regarding the dynamical principles underlying some of the methods indicated. For example, the lowering of the grip of the right hand in defensive strokes, as when the player plays back, is the obvious way of getting a more powerful couple to act on the bat and prevent it being rotated by the impulse of the ball. The player probably does not think of it in that way, but by experience he has found it to be the most effective method. The important distinction between wrist play and arm play is referred to again and again, and the value of wrist play insisted upon with great incisiveness. It seems to us, however, that Mr. Fry occasionally directs attention to evidence of powerful wrist play in certain attitudes where, strictly speaking, it does not to any marked degree exist. To bring out our meaning more precisely, let us suppose the batsman is taking his stand at the wicket. His first position with the bat resting in the block hole and his eyes looking towards the bowler gives him such a stance that when he rises upright with the bat drooping easily in front of him the face of the bat is directed straight towards the bowler. This is the zero position through which the bat will swing with its face always properly oriented. If he lifts both arms at the same rate by a rotation about a horizontal axis parallel to a line through the shoulders, the face of the bat will still look in the same direction; but if he moves the arms in any other way the conditions of the geometrical constraint imposed by the grip of the hands on the handle will necessitate a combined rotational and translational motion. Let anyone with bat in hand try to shape for a drive or a cut and endeavour at the same time to prevent the bat rotating round its own axis of figure, and he will find himself forced into the most awkward and constrained of attitudes. In the description of plate xxii., showing Grace preparing for the on-drive the finish of which we have reproduced, the last sentence reads thus: "If you study the turn of his bat you will see that in order to bring the face of the bat against the ball he must put in a pronounced turn of the wrist." The truth is that if the right elbow is kept down the bat must take the position shown, and the accompanying *turn* of the wrists is slight, involuntary, and *natural*, and mainly in the left wrist. In plate xxiii., reproduced above, the geometrical conditions of constraint compel a rotation of the bat round its axis in the opposite direction. Let anyone go through the motions slowly with the initial and final attitudes as shown in these two plates, and he will find the bat take the positions pictured passing through the zero position with face looking front, and through the whole motion he will not be *sensible* of any wrist action at all. The coordinated but geometrically

complex movements of arms and body give to the bat held by the two hands a complex screw motion which may approximately be described as a rotation about an oblique axis outside the bat altogether. Plate ii. of L. C. H. Palairet's series, showing his second position, is a perfect illustration of the remarks just made; with the attitude of body and arms as given it would be impossible for the bat to have any other position without an unnatural turn of the wrists.

The effect of the true wrist-action is well described in the later part of the book. It is as effective in cricket as in golf, bringing into play a rapid acceleration just at the instant of impact. It is at the foundation of all graceful batting. As Mr. Fry well remarks, "wrist-work is the chief secret of a versatile, neat and effective style."

The book is full of a great variety of most interesting and instructive points. Those among us whose cricket is a memory will almost wish they were twenty or thirty years younger if only for the chance of testing the soundness of the teaching of Messrs. Beldam and Fry's remarkable volume; while the youthful devotee eager to improve himself in the most attractive part of our national sport will get many valuable hints from a careful perusal of its pages and study of its pictures. C. G. K.

NOTES.

The council of the Royal Meteorological Society has awarded the Symons gold medal to Lieut.-General Sir Richard Strachey, G.C.S.I., F.R.S., in recognition of the valuable work which he has done in connection with meteorological science. The medal will be presented at the annual general meeting of the society on January 17, 1906.

The suggestion made by Prof. Milne in our correspondence columns this week, that an intercolonial meeting of the British Association should be held in London, is well worthy of consideration. Such a conference of representatives of science in British dominions beyond the seas and at home would strengthen the bond of union existing between them, and do something to coordinate the intellectual forces of our Empire. It is essential that men of science widely separated from one another should have opportunities of exchanging opinions upon investigations and results in which they are interested; and the advantages of such conventions are felt long after the meetings have ended. It is probable that Prof. Milne's proposal will meet with the approval of members of the association engaged in scientific work.

Members of the British Association who recently visited the Victoria Falls will be interested to learn that the small herd of hippopotami that frequents the islands above the Falls, and adds substantially to the attractions of the place, has again become troublesome. Apparently the animals have been irritated by the increasing traffic on the Zambesi; for a note in *South Africa* of November 18 states that several boats have been upset, causing one fatality and several narrow escapes. "Hippo, from any sentimental point of view," it is remarked, "are hardly the sort of things to be preserved as pets on a portion of the river where there is constant traffic, and it is to be hoped that every effort will be made to exterminate them before more serious accidents occur. . . . Those desirous of seeing the hippo in their natural haunts should find some more solitary spot where there is less danger to human life."

The *British Medical Journal* announces that the next meeting of the German Society of Experimental Psychology will be held at Würzburg on April 10–13, 1906. Reports will be presented on the following subjects:—(1) The relations between experimental phonetics and psychology (by E. Krueger); (2) experimental æsthetics (by O. Kuelpe); (3) the psychology of reading (by F. Schumann); and psychiatry and individual psychology (by R. Sommer).

The account of the surveying work connected with the construction of the Simplon Tunnel, in Nature of November 9 (p. 30), may be supplemented by the following final results, which have just been ascertained and are described in the *Times* of November 18 by Mr. Francis Fox. The actual measurements are as follows: The length of the tunnel, which is $12\frac{1}{2}$ miles, proves to be greater by 31 inches. The levels of the two galleries were within $3\frac{1}{2}$ inches of one another. As regards direction, the axis of the tunnel, driven from the north end, deviated 4 1-3 inches towards the west, whilst the line driven from the south end deviated 3 2-3 inches towards the east; consequently the greatest divergence from the true line was 4 1-3 inches, which is well within the calculated probable error.

A *Times* correspondent gives in the issue of November 20 a graphic description of the means taken to stamp out yellow fever in Panama. The first cases of the disease were concealed, and it was not until a serious epidemic was in progress that President Roosevelt, on his own initiative, Congress having refused to aid him, appointed Judge Magoon to Panama as Resident Governor of the canal zone with autocratic power. The prevalence of fever was bad enough, but the demoralisation of public spirit in the American colony was worse. Governor Magoon found that, while some in utter panic were fleeing from the isthmus as a plague-spot, others had fallen into a state of cynical bravado. They professed contempt for the mosquito theory of disease dissemination, and refused to obey the preventive rules which had been formulated. They took a boastful delight in exposing themselves to mosquito bites, and tore holes in the netting which had been placed over the windows of the office buildings and hotels. The Governor soon changed all this, expressed his own fear of the disease, insisted that the evidence of the transference of the disease by mosquitoes was overwhelming, and arranged for the fumigation of every building in the city. Medical inspectors were also appointed who daily examined every inhabitant. The effect of these measures is shown by the figures of the incidence of the disease:—in May there were 38 cases; in June 62 cases; in July, after the institution of these measures, 42 cases; in August 27 cases; in September 6 cases; and since then not a single case, although a reward of 50 dollars, gold, has been offered for a notification.

Mr. C. O. Stevens, writing from Bradfield, Reading, states that on Friday last, November 17, widespread attention was attracted and curiosity aroused by sounds as of heavy-gun practice and rifle firing that made themselves felt, as well as heard, in the neighbourhood for miles around. They occurred, on and off, from about 11.30 a.m. until 4 p.m.

To the Irish Fisheries Board we are indebted for a copy of the first instalment of a list of the marine copepod crustaceans of Ireland, by Mr. J. Pearson, published as No. 3 of "Scientific Investigations" for 1904. The author states that previous students have mainly confined their investigations to the pelagic types, and that consequently

much remains to be ascertained concerning the parasitic and bottom-dwelling forms. The present section deals with littoral types and those infesting fish.

IN the report of the council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, attention is directed to the important work which has been recently accomplished in the matter of scientific publications. Unfortunately, this has somewhat crippled the society's resources, and unless additional support be accorded a pause must be made in the good work. It is estimated that the total number of visitors to the society's museum during the year will be about 17,000.

THE October issue of the *Emu* contains some beautiful photographic illustrations of the haunts and nests of the Australian lyre-bird, as well as of the bird itself. It is, however, sad to learn that, in the opinion of Mr. Kitson, the author of the accompanying notes, the lyre-bird is destined to disappear ere long from the Victorian bush unless it develops the habit of nesting in trees, as is occasionally its practice at the present time. The main persecutor is the European fox, which has been introduced with only too much success into its haunts. In South Gippsland, on the other hand, man is the criminal, and breech-loaders, forest spoliation, and bush-fires will, it is thought, before long complete their fell work, and render the lyre-bird unknown in a district where it formerly occurred in thousands. A supplement to this issue contains a useful "key" to the birds of Australia drawn up by Mr. A. C. Campbell on the "dichotomous" plan, that is to say, by according two contrasting diagnostic characters to each species.

WE regret to have to record the death of that eminent French naturalist Jean Frédéric Émile Oustalet, of whom a brief obituary notice is published in a recent issue of *La Nature*, to which journal the departed zoologist was a constant contributor. Born at Montbéliard on August 24, 1844, Oustalet passed the whole of his scientific career in the service of the Paris Museum, which he entered as an assistant in 1875. In August, 1900, he became professor of "mammalogy," with special charge of the menagerie, and co-director of the École des Hautes Études. He died "in harness" at St. Cast (Côtes du Nord) on October 26. The laureate of the Institute of France in 1877, Mr. Oustalet was secretary to the committee for ornithological investigations, and president of the Ornithological Congress in 1900. He was a Chevalier of the Legion of Honour, and had likewise received decorations from other countries. Among his more important works may be cited "Recherches sur les Insectes fossiles," "Monographies des Mégapodes," and "Les Oiseaux de la Chine."

THE *Journal of the Royal Sanitary Institute* for November (xxvi., No. 10) contains an address by the Duke of Northumberland on the occasion of the opening of the new hospital for infectious diseases at Newburn; Prof. Kenwood's address on the public health delivered at the opening of the medical session at University College; particulars of model cottages at Earswich, York, by Mr. Appleton; and a discussion on aspects of the pure milk question, together with notes, reviews, &c.

THE Michigan State Agricultural College Experiment Station has issued two useful Bulletins (June). No. 229 details interesting observations by Mr. Marshall on the associative action of bacteria in the souring of milk. Experiments prove that the activity of lactic acid-forming bacteria may be much increased by admixture with another bacterium which itself does not produce lactic acid. In No. 230 Mr. Sackett describes several bacterial diseases of plants prevalent in Michigan, viz. pear blight, bacteriosis of beans, black rot of cabbage, wilt of cucumber, soft rot of sugar beet, and blight of Irish potato, tomato, and egg-plant.

IN the *Arkiv for Botanik* (vol. v., No. 3) Dr. J. Eriksson takes up the subject of the origin and spread of rust diseases in plants to combat the views of Klebahn, Marshall Ward, and others. Criticising the argument that the *uredo*-stage can carry infection through a severe winter, he lays stress on the want of proportion between the development in autumn and the intensity of the disease in the following summer.

As the first of a series of articles to appear in the *Indian Forester* on Indian forest fungi, Mr. E. J. Butler describes a trichosporium disease observed in Casuarina plantations; the fungus spreads through the cambium and ruptures the bark. Considerable interest attaches to the notes by Mr. F. B. Manson on the preparation and sale of rubber grown on the rubber plantation at Mergui, from which it is evident that good Para can be produced in Lower Burma.

IN a small brochure ("Die Lichtentwickelung in den Pflanzen") Prof. H. Molisch deals with the subject of light emission by plants. The production of light is confined to fungi, bacteria, and Peridineæ in the plant world. Prof. Molisch determined that the luminosity of meat is caused by a bacterium, and showed that the bacterium can generally be produced in a few days by partially immersing a piece of meat in brine. The emission of light from wood has been traced to the same source, and similarly decaying leaves of oak and beech may become luminous. The connection between nutrition, growth, and luminosity has been studied by Beijerinck. As to the teleological factor in the production of light, little is known except that it is an oxidation process; Prof. Molisch postulates a substance, photogen, that produces light waves in the presence of oxygen.

A SCHEME of no little interest, and worthy of generous support, has been initiated by the Midland Reafforesting Association for planting trees on the spoil banks in the black country. Anyone who has traversed the road from Wolverhampton to Dudley by way of Gornal will have realised something of the former beauty of this district. The object of the association is to prove that plantations are still feasible on the unsightly pit-mounds that cover the land. Last autumn a six-acre plot was planted at Wednesbury and a small model plantation was formed at Old Hill. The extension of the work that is now in progress makes it necessary to employ a paid organising secretary. To provide funds for this purpose, and to obtain a larger balance than is at present available as working capital, Sir Oliver Lodge, the president of the association, is appealing for contributions. The honorary secretary is Mr. P. E. Martineau, Bentley Heath, Knowle, Warwickshire.

SEVERAL interesting memoirs have been issued by the Geological Survey of Queensland. One of the most valuable of these is a general index (Publication No. 197) to the various reports issued by the survey (Nos. 177 to 196), compiled by Mr. Russell Dixon. In Publication No. 196 Mr. B. Dunstan gives notes on the gold deposits near Mount Ubi, on the iron ore of Mount Lucy, on testing samples for prospectors, on monazite in Queensland, on a soil survey for Queensland, on boring for coal near Townsville, and on the testing of Queensland coals. He

also gives some mineralogical notes on agate pebbles occurring in abundance on the surface of decomposed basalt at Little River, on penetration-twin crystals of gypsum from Eukalunda, on tellurides of gold, silver, and lead (hessite and altaite) from Gympie, and on calcite crystals with pyrites inclusions from Golden Gate, Croydon. In Publication No. 198 Mr. Lionel C. Ball describes the occurrence of gold, platinum, tinstone, and monazite in the beach sands on the south coast of Queensland. The results obtained indicate that this is a favourable field for the use of a dredger. In Publication No. 199 Mr. Lionel C. Ball gives a preliminary report on the recent discovery of gold at Oaks View, near Rockhampton. The ore is a soft ferruginous material resulting from the alteration of an original serpentine. In Publication No. 200 Mr. Walter E. Cameron describes the central Queensland (Dawson-Mackenzie) Coal-measures. The coal is of permo-Carboniferous age, and a promising forecast is given of the great resources of this portion of Queensland in high-class steam-coal.

THE pretty and well known lecture experiment showing the alternations between longitudinal and torsional oscillations in a suspended spiral spring carrying a weight was described by Wilberforce in 1894. In the *Festschrift* commemorative of the seventieth birthday of Adolf Wüllner (Leipzig: B. G. Teubner, 1905) Prof. A. Sommerfeld describes some further experiments with spiral springs and discusses their use in the determination of Poisson's ratio. The following methods are distinguished:—statical observations, observations of the separate oscillation periods, construction and measurement of the Lissajou curves, determination of the conditions of resonance.

IN the *Arkiv* for mathematics, astronomy, and physics of the Swedish Academy, Mr. W. Walfrid Ekman gives an investigation (in English) on the influence of the earth's rotation on ocean currents. It had been observed by Dr. Nansen on the *Fram* that the drift produced by a given wind did not follow the wind's direction, but deviated some 20°–40° to the right, and a mathematical investigation by the writer of the present paper showed how this deviation could be accounted for by the earth's rotation. In the present communication account is taken of the influence of continents and of neighbouring currents. The calculations show the existence of a surface current tending somewhat to follow the shore lines, but deviating 45° from the direction of the wind in the absence of boundaries, a midwater current with a velocity almost uniform and parallel to the coast, lastly a bottom current compensating for the flow of water towards or from the land in the surface current.

THE *Popular Science Monthly* for November contains a note by Prof. Mansfield Merriman on the "cattle problem" of Archimedes. This problem occurs in the form of a poem of forty-four lines in a manuscript in the library of Wolfenbüttel, and it was brought into notice by Lessing shortly after his appointment as librarian there in 1769. The problem consists, in the first place, in determining the total number of cattle grazing on the plain of Sicily, divided into white, black, dappled, and yellow bulls and cows, from seven equations of condition connecting the numbers in the eight various categories. The problem in this form is easy, but a further rider imposes the additional conditions that the number of white and black bulls shall be a square number, and the number of dappled and yellow bulls a triangular number. Amthor showed in 1880 that numbers satisfying these conditions could be found, but instead of the total number representing a possible herd of cattle, it would consist of no less than 206,545 digits. Finally, in 1889 Mr. A. H. Bell, in conjunction with two other mathematicians, began the work of solution, and in the course of four years determined the first thirty or thirty-one and the last twelve digits of the actual numbers. It is, however, pointed out that to determine all the 206,545 digits would occupy a thousand men for a thousand years.

IN No. 2, vol. xxii., of the *Astrophysical Journal* Mr. W. W. Strong, of the Dickinson College, Carlisle (Pa.), describes the results obtained from a series of experiments on the spectrum of the magnesium spark under various conditions. The spectra were photographed with a 4-inch Rowland grating having 14,400 lines to the inch. Using magnesium poles, he found that the "principal series" lines (λλ 2802 and 2795) and the line at λ 2852 were reversed in the end-on positions, but if a copper or iron pole were substituted for one of the magnesium poles, and the remaining magnesium pole was placed *away* from the slit, the reversals did not occur. This seems to indicate that the reversals are caused by the surrounding vapour of magnesium, and, to prove this, the spark was made to pass between an iron and a magnesium pole through a fine hole. For holes of less than 0·5 mm. in diameter this "reversing layer" was entirely cut off, and the spectrum of the spark between the hole and the *iron* pole *never* showed any reversal. Other results, in connection with other lines, were also obtained, but an attempt to get a measurable "Doppler" effect was defeated by the diffuse nature of the lines.

THE Journal of the Meteorological Society of Japan for June last contains several useful articles, including one (in Japanese) by I. Hattori on oyster development and meteorological conditions, and notes on the climate of the Bonin Islands (in English) by T. Okada. In the summer of 1901 a station was established by the Tokio Meteorological Office at Peel Island, one of the largest of the group; the station is situated in lat. 27° 5′ N. and long. 142° 11′ E. In addition to the automatic records, observations have been regularly made at 10h. a.m. and 2h. p.m., and the results are published for the years 1902–4. The principal facts relating to this isolated Pacific station may be interesting to some of our readers. The mean annual temperature is 71°·8, the mean monthly maximum being 79°·5, in August, and the minimum 61°·5, in January; the highest temperature recorded was 91°·4, in September, and the lowest 45°·5, in February; no frost or snowfall has been recorded, and vegetation is astonishingly luxuriant. North-westerly winds blow almost constantly from December to February, inclusive; the easterly monsoon prevails from July to October, inclusive. The rainy seasons are June and September, and the driest months are April and January; the total annual rainfall is about 54 inches, and, on an average, there are 147 rainy days in a year. The mean annual relative humidity is 75 per cent.

IN the October number of the *Journal de Physique* M. H. Buisson gives particulars of a new determination of the mass of a cubic decimetre of pure water. The author criticises the usual method of determining the volume of a solid by measurement of the linear dimensions; in his experiments two parallelepipeds of quartz, almost cubes, of four and five centimetres edge were used, their densities, and hence their volumes, being determined by the hydrostatic method, after correcting all the data to 0° C. The geometrical dimensions of the cubes were then ascertained by two distinct optical methods based on the

principle of interference. By a comparison of the two sets of values, the ratio of the litre to the cubic decimetre was found in two determinations to be 1·000026 and 1·000029 respectively. The error on the kilogram is thus +26 to +29 milligrams.

MESSRS. SWAN SONNENSCHEIN AND CO., LTD., have published a third edition of "Sanatoria for Consumptives," by Dr. F. Rufenacht Walters. The book, the first edition of which was reviewed in NATURE for July 6, 1899 (vol. lx. p. 221), gives a critical and detailed description, together with an exposition, of the open-air or hygienic treatment of phthisis.

DR. H. C. VOGEL, director of the Astrophysical Observatory at Potsdam, has edited the third edition of Newcomb-Engelmann's "Populäre Astronomie," published by Mr. W. Engelmann, Leipzig. Many additions have been made, both to the text and illustrations, particularly in the sections devoted to spectrum analysis, photometry, photography, and other branches of astrophysics; and the whole work has been satisfactorily revised. Short biographies of deceased astronomers from Thales to Keeler, arranged according to their years of birth, are given near the end of the volume.

WE have received from Mr. H. K. Lewis, 136 Gower Street, W.C., a copy of No. 23 of his *Quarterly List* of additions to the circulating library. The list contains more than 100 titles, and includes several important new books and new editions on the various subjects covered by the library. There are brief notes to most of the books which, while not pretending to give the subscriber an exact idea of the book, enable an opinion to be formed on its general scope. On looking through the books included we notice that, since the first number appeared, considerable extension in the scope of the library has taken place. The library has been long known as a useful medium for the supply of medical literature, and the inclusion of all branches of technological and general scientific books, commenced some two or three years ago, should add to its value.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A COMET, 1905*b*.—A telegram from the Kiel Centralstelle announces the discovery of a comet by M. Schaer at Geneva on November 17. At 8h. 7·8m. (M.T. Geneva) the position of the comet was

$$\text{R.A.} = 4\text{h. } 22\text{m. } 32\text{s., dec.} = +86°.$$

The apparent daily movement of this object is given as $-54°$ in R.A. (*i.e.* 3h. 36m.) and $-1°$ in declination.

A second telegram from the same source announces that the comet was observed at Bamberg on November 18·075. The position, at 6h. 50·6m. (Bamberg M.T.), was

$$\text{R.A.} = 0\text{h. } 58\text{m. } 19·5\text{s., dec.} = +80° \ 40' \ 5''.$$

It thus appears that this object was first seen near to Polaris, and is now travelling quickly down through Cepheus towards Cassiopeia.

NOVA AQUILÆ NO. 2.—The results of a number of observations of Nova Aquilæ are recorded in No. 4052 of the *Astronomische Nachrichten*.

On September 29 Prof. Wolf recorded the magnitude of the Nova as 9·6–9·7, which indicated scarcely any decrease in the brightness since September 17.

A photograph, taken on October 16 with fifty-six minutes' exposure, showed, however, that the Nova's magnitude had decreased to 10·8, that is to say, it had fallen about 1·2 magnitudes in seventeen days. On this photograph the image of the Nova is surrounded by a faint uneven halo 1′ or 2′ in diameter.

THE TENTH SATELLITE OF SATURN.—No. 9, vol. liii., of the Harvard College Observatory Annals contains an account, by Prof. W. H. Pickering, of the discovery of Saturn's tenth satellite, to which the name Themis has been allotted.

So far no variation of the satellite's brightness has been detected, its magnitude remaining constant at about 17·5. As this magnitude is beyond the power of existing telescopes, the satellite can never be observed *visually* until more powerful instruments are available. The probable diameter of Themis is about 38 miles; the orbit of the satellite is inclined about 39°·1 to the ecliptic, and its eccentricity and semi-major axis are about 0·23 and 906,000 miles respectively. The period of revolution is 20·85 days. As the observational data are, as yet, so few, all the above values are to be considered as only approximate. A drawing accompanying the description represents the orbit diagrammatically.

Owing to its great eccentricity, the orbit of Themis crosses the orbits of both Hyperion and Titan, and, when near to these bodies, the newly discovered satellite must suffer enormous perturbations, the results of which are discussed in Prof. Pickering's paper.

THE EVOLUTION OF THE SOLAR SYSTEM.—Another alternative to Laplace's theory of the formation of planetary systems is suggested in an article by Mr. F. R. Moulton, of Chicago University, in the *Astrophysical Journal* for October. In 1900 this writer and Prof. T. C. Chamberlin examined the older hypothesis from the dynamical standpoint, and found so many conclusive contradictions as to lead them to abandon it.

The theory now suggested supposes that the planets and their satellites have been formed around primitive nuclei of considerable dimensions existing in a spiral nebula probably similar to those which Prof. Keeler showed to be many times more numerous than all the nebulæ of other types.

The growth of each nucleus was caused by the gradual accretion of smaller masses, and the method of this growth which is suggested accounts for all the different types of bodies now found in the solar system, and for their present motions and velocities, on dynamical principles.

The original spiral nebula is supposed to have been formed by the near approach of another star to the body which is now our sun. This exterior attraction set up tides in the solar matter, and, being continued, actually caused immense masses to be ejected and drawn out into the spiral form. On this assumption the spiral would emerge from the central nucleus in two directions, on opposite sides, and this is the form generally shown on photographs of such nebulæ.

Mr. Moulton's paper considers at length the explanation, on this hypothesis, of the existing conditions, and a fuller exposition of the theory is promised in a new work which is to be published shortly.

CATALOGUE OF VARIABLE STARS.—No. 7, vol. liii., of the Harvard College Observatory Annals contains a second supplement to the provisional catalogue of variable stars which was issued in a previous volume of the Annals. The original intention of the Harvard authorities was to publish a supplement, similar to the one issued in 1903, every five years, but the large number of variables recently discovered renders a change of plan necessary. More than 400 variables are included in the present supplement, many of them belonging to the nebulous regions investigated by Miss Leavitt.

During 1904 the number of variable stars was increased by 503, of which 431 were discovered photographically at Harvard. The card-catalogue of variables which is being compiled at Harvard now comprises about thirty-five thousand cards.

STAR CALENDAR FOR 1906.—We have received a copy of a very useful star calendar compiled by [H.P.H.], and published by Messrs. Hirschfeld Bros. The calendar consists of four cards designed to hang on the wall for ready reference. Each card contains the ordinary date-calendar for the quarter, a table showing the positions of the planets in regard to the constellations, and a star map so marked that the constellations and stars which may be observed on any evening during the quarter, may be instantly recognised by their relative positions in regard to the cardinal points and to the zenith. The price of the calendar is 1*s*. net.

NEW MUSEUM AND LABORATORIES OF ZOOLOGY AT LIVERPOOL.

THE new museum and laboratories of zoology of the University of Liverpool were opened on Saturday last, November 18, by the Earl of Onslow, formerly President of the Board of Agriculture and Fisheries, and now chairman of committees of the House of Lords.

The history of the department of zoology at Liverpool and the character of the new buildings are described in a pamphlet issued by the university, and abridged at the end of this record of the opening ceremony.

Preparatory to the actual ceremony of inauguration at the new building, there was a large gathering in the arts theatre of the university of guests of the council and senate of the university. Apologies and letters of regret for unavoidable absence were received from the president of the Royal Society, Sir Archibald Geikie, Prof. Ray Lankester, Sir Henry Roscoe, and many other men of science. A resolution passed at the meeting of the Linnean Society of London on November 16, signed by the officers, and congratulating the University of Liverpool and their president (Prof. Herdman) on the new laboratories, was received.

Dr. Nansen had accepted the invitation and hoped to be present, but at the last sent his regrets and a telegram saying:—"Hearty congratulations to the Zoological Department of the University of Liverpool.—NANSEN."

Lord Onslow was introduced to the assembly by the Chancellor, the Earl of Derby; and in the course of his remarks he is reported by the *Liverpool Daily Post and Mercury* to have spoken as follows:—

LORD ONSLOW ON SCIENCE AND THE STATE.

In the first place he wished to congratulate the University of Liverpool on their decision to set apart a sum sufficient properly to equip the museum and laboratories of the natural history and zoological department of the university. He thought that was a wise step, but it was a step which could only have been accomplished, in common with all the rest of the work of the university, by the great liberality of the captains of industry in Liverpool, who had realised that the application of science to commerce was one of the most important things for commerce itself. When he looked back on the list of benefactors to the Liverpool University, he found the names of Brunner, Holt, Tate, Johnston, Rathbone, and others, and he was struck by the fact that in Liverpool at any rate the application of science to commerce was thoroughly appreciated. Although there was in this country a great amount of private wealth and of private benefaction, he was afraid it must be confessed that the amount which had been devoted to the promotion of university education "pales its ineffectual fires" before what had been done in America. In the United States of America as much as 7,000,000*l.* had been bequeathed or given in two years to the purposes of university education. What was the reason for that? He thought that in a large measure it was due to the great difference between the United States of America and this country. The difference was that in the United States there were no hereditary honours or titles, and if a man wanted the future generation to have a record of his existence it could only be done by associating his name either with a university or with a chair in that university, or by some other great benefaction. The result was that the United States had rich universities, such as that of Cornell, founded by individuals, and he confessed that if he were a man of great wealth he would much rather posterity would remember him as having founded a university or a chair of a university than as having been a liberal subscriber to the funds of his party. Though a good understanding existed between this country and other Great Powers, provision should be made for the war in commercial supremacy. What were the armaments with which we were to provide ourselves for the purposes of defence in the war of commercial supremacy? They were those provided by science and by scientific research. Fortunately for us, the inventions of science could not be patented in the interests of any one particular country, but the slightest improvement upon them could, and it was those improvements, arrived at by scientific research, which would make or mar the supremacy of any country in commerce. The power of adding to a train-load that could be carried by a locomotive in the other hemisphere might make a difference of two shillings in the price of corn, which was the shuttlecock between the political parties at the present time. It was the same with all our manufactures. The greatness of England in the past century had been due to men of science like Faraday, Watt, Stephenson, and Kelvin. Were we doing all that we ought to see that any latent genius in the whole of the British nation got the opportunity to come out, and to give to the world those great triumphs of scientific research from which this country had so enormously benefited? He thought it must be confessed that until quite recently education in this country was in a chaotic state. Even now it was only in favoured cities and places that there was anything like an educational ladder by which an intelligent boy at the national school could, without cost to his parent, work his way up until he took a university degree, and could devote himself to scientific research for the benefit of his fellow-countrymen. He had great hopes that a spirit was arising in the nation now which saw the necessity of those educational facilities, and that by the assistance and liberality of our citizens they would build up from the lowest to the highest facilities that every citizen could avail himself of. There were two great public questions before the people

FIG. 1.—New Buildings of the Department of Zoology, University of Liverpool.

of this country upon which the prosperity of the future of the country depended. One of them was the re-organisation of the Army, and the other was the organisation of the education of the country. Both those questions required the expenditure of large sums of money, and he did not believe that under the present system it would be possible to obtain those large sums unless in some manner or another they could see their way to broaden the basis of taxation. When the business of the fisheries of the country was handed over to his (Lord Onslow's) department he naturally expected, as an ignorant Minister did, that he would find the broad lines upon which it was expected that he should shape his policy already laid down by experts and men of science. But instead of that he found a wall of ignorance as regarded everything that affected the biological and physical condition of our territorial waters. What they wanted to know was by scientific research whether anything could be done to stem the depopulation of the ocean if that depopulation was actually know how to protect human beings from the danger of eating contaminated shell-fish. They had done much in the Liverpool University for the study of tropical diseases; they had ascertained much to protect the lives of their fellow-subjects who went out to the malarial coasts of West Africa; he sincerely hoped that they would be able also to show them how they could avoid pollution from the contamination of shell-fish. He hoped that all who had worked in the laboratories of the university would be stimulated to greater efforts by the better buildings in which they would be housed.

The Chancellor read a communication received from Sir Thomas Elliott, Permanent Secretary of the Board of Agriculture and Fisheries, intimating that the Board were pleased to award the university a grant of 200*l.* for the financial year ending March, 1906, in respect of the zoological work carried on in connection with the fishing industry, and conveying the congratulations of the Board on the completion of the zoological museum and labor-

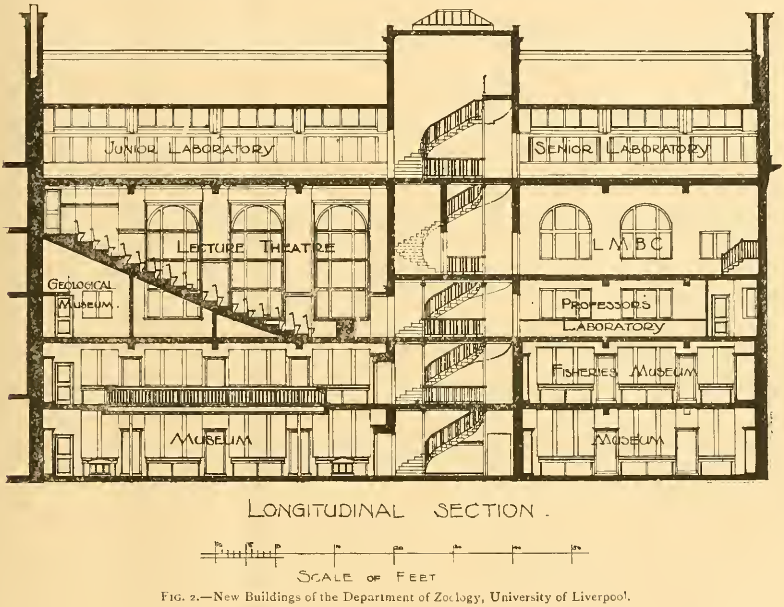


FIG. 2.—New Buildings of the Department of Zoology, University of Liverpool.

going on. That work must be divided under two heads—statistical and biological. The statistical work could not, of course, be properly performed by a university such as that. That was a matter which must be taken in hand by the central authority. He looked very largely to the Lancashire Sea Fisheries Committee, acting in conjunction with the University of Liverpool, to pursue the biological part of those inquiries. He was in hopes that when the expenditure of this country upon the international investigation of the North Sea came to a close there might be national funds available for assisting them in the research which they had undertaken for some time past, and which he could not doubt but with the opening of those new buildings would be largely stimulated and increased, and that thereby they might be assisted by them to solve problems which were great and national. There was also the great and important question of the connection of human disease with shell-fish. They wanted to find out to what extent there was contamination in shell-fish, and also what was not dangerous to the human frame. It was really of the very greatest possible importance that they should

atories, which they hoped would be of service "both in the advancement of scientific knowledge and in the solution of many problems of importance to the fishing industry." Sir Thomas Elliott afterwards spoke.

Replying to a vote of thanks moved by Mr. E. K. Muspratt and seconded by Sir John Brunner, M.P., Lord Onslow said he was not by any means alone in his appreciation of not only the benefit, but the absolute necessity of all Government departments in their respective spheres availing themselves of the advantages of scientific research. It applied not only to Government departments, but equally to all the great industries, to the Navy and the Army, and to every branch of national enterprise. In regretting that the 200*l.* contribution to which Sir Thomas Elliott had referred was regarded as small, Lord Onslow said it was not the Board of Agriculture who was rich, it was the Chancellor of the Exchequer, and when they got a few thousands out of the Chancellor of the Exchequer for all the purposes of agriculture and fisheries, they thought they had done very well when they were able to contribute 200*l.* to one place.

The proceedings in the arts theatre then ended, and Lord Onslow and the council and senate and guests walked through the university grounds to the new zoology buildings, where, after a short speech by Prof. Herdman, Sir John Murray addressed the assembly upon oceanography. Mr. R. B. Haldane also delivered a brief speech, in the course of which he remarked that by obtaining the grant of 200*l*. from the Chancellor of the Exchequer Sir Thomas Elliott had established a principle and connected the University of Liverpool with His Majesty's Government.

THE DEPARTMENT OF ZOOLOGY.

The Derby chair of natural history was established by the fifteenth Earl of Derby in 1881—an appropriate gift from a descendant of the scientific founder[1] of the celebrated zoological collections once alive at Knowsley and now secured to Liverpool in the Derby Museum of the Public Galleries. The first Derby professor was appointed at the end of 1881, and thus natural history was one of the three or four scientific departments with which University College opened in January, 1882. The work of the Liverpool Marine Biology Committee has been so intimately bound up with the Natural History Department during the last twenty years that, although not, strictly speaking, a part of the university organisation, it is impossible to omit a brief record of its history. Established for the purpose of exploring the fauna and flora of Liverpool Bay and the neighbouring parts of the Irish Sea, it brought a number of the local field-naturalists into close relation with the university department and laboratory methods, it gave rise to dredging expeditions and observations and experiments at sea, which led on in later years to sea-fisheries investigations, and it resulted in the accumulation of collections which have proved of considerable interest and scientific value. The "local" collection in the museum of the new buildings has been almost wholly obtained through the work of the L.M.B.C.

Probably the most important outcome of this exploring work has been the establishment of a marine biological station on the west coast of England. After five years' use of an old Dock Board observatory on Puffin Island, off Anglesey, the committee moved their marine station to Port Erin, at the south end of the Isle of Man, where they have now a substantial, new, two-storeyed building, measuring 95 feet by 45 feet, containing laboratories, an aquarium, and a fish-hatchery, and provided with a large, open-air, sea-water pond for the spawning and rearing of fish. As to the results obtained from this institution (which is under the direction of the Derby professor, and is worked in connection with the university department), it will suffice to state that during the last year thirty-six investigators worked in the laboratory, about five millions of young plaice were sent out to sea from the fish-hatchery, and more than thirteen thousand visitors paid for admission to the aquarium.

It was certainly to this marine biological work in the past that the natural history department owed in the first instance that connection with the local sea-fisheries authorities which has recently developed into a formal agreement between the university and the Lancashire and Western Sea Fisheries Committee. The scientific work of the local fisheries district is carried on in the laboratories by assistants paid by the Fisheries Committee, and the professor has been appointed honorary director of the scientific work, and furnishes an annual report on the work of the fisheries laboratory. A share of the laboratory accommodation in the new buildings will be devoted to the furtherance of the work of the Liverpool Marine Biology Committee, of the Lancashire and Western Sea Fisheries Committee, of economic entomology, and of other useful applications of zoology.

It has been recognised for some years that the accommodation in the old college buildings was quite inadequate to meet the wants of this department, and although some extensions had been made, such as a wooden fisheries laboratory on the roof and a convenient little museum (given about ten years ago by the late Mr. George Holt), these were temporary expedients which in some ways only emphasised the pressing need for new and much larger buildings. Research work offered to the department was hampered, and in some cases had to be declined for want of room. These facts were given expression to in the statements of needs drawn up in connection with the university movement of 1901–2, and after the establishment of the university a sum of 18,000*l*. was voted to the council by the university committee in October, 1902, for the purpose of erecting and equipping a new department of zoology, to contain a museum and a lecture theatre, the necessary students' laboratories, and also accommodation for sea fisheries investigations and other lines of marine biological research.

[1] The thirteenth Earl of Derby, President of the Linnean Society, 1828–1833, and subsequently President of the Zoological Society.

THE NEW BUILDINGS.

This zoological institute has a frontage of 123 feet on the western side of Brownlow Street, is 41 feet from front to back, and 84 feet in height from the street level. It is built of red pressed brick relieved with white sandstone from the Storeton quarries in Cheshire. The building consists of a central tower containing the entrance hall and staircase and some of the smaller rooms on each floor, and of two blocks, the north and the south, which have been treated rather differently as regards internal structure. The south block has only three main floors, while the north has five in the same height. The central tower extends a storey higher. In the south block the three floors accommodate (1) the museum with its large gallery; (2) the lecture theatre; and (3) the large junior laboratory at the top of the building. In the north block, on the two lower floors there are extensions of the museum to receive special collections, and the rest of the space is devoted to the senior class-room, senior and honours students' laboratories, the departmental library, and rather large laboratory and store-room accommodation for the sea fisheries department, the work of the economic entomologist, of the marine biological committee, and other practical applications of zoology. In the central tower, along with the staircase, there are small rooms for the professor and two demonstrators, the laboratory assistant, with diagram, chemical, aquarium, photographic, macerating rooms and students' lavatories.

GEOLOGY AT THE BRITISH ASSOCIATION.

IN Section C the papers read were largely on subjects of local interest, and in many cases by South African geologists. The delivery of the presidential address in this section having been fixed for the meeting at Johannesburg, the proceedings at Cape Town were opened with a short address of introduction by the president, followed by a lecture by Mr. A. W. Rogers, the director of the Colonial Geological Survey, on the outlines of the geology of the Cape Colony.

Among the subjects discussed, the Karroo claimed a considerable share of attention. Prof. R. Broom, in a paper on the classification of the Karroo beds, retained the division into Dwyka, Ecca, Beaufort, and Stormberg series. He subdivides the Beaufort series into three, and the Stormberg into two parts on reptile evidence, and correlates the various divisions with European strata thus:—Dwyka and Ecca series with Lower and Middle Permian, Lower Beaufort beds with Upper Permian, Middle and Upper Beaufort beds with Lower and Upper Trias, Lower Stormberg beds with Rhætic, and Upper Stormberg beds with Lower Jurassic.

Mr. A. L. du Toit gave an account of the Stormberg formation in Cape Colony. This uppermost division of the Karroo beds consists of a considerable thickness of nearly horizontal sandstones, shales, and volcanic rocks, and includes (in descending order):—(4) Volcanic Beds; (3) Cave Sandstone; (2) Red Beds; (1) Molteno Beds. The formation covers a considerable area in the east of the colony, in the Stormberg and Drakensberg districts, the summits of the mountains being commonly formed of the lava flows of (4). The sediments were deposited in an inland sea, the "Karroo Lake," the southern shore-line of which ran along the present coast-ranges of the colony, and thence north-eastward, outside and parallel with the coast-line of Natal. The author suggests the correlation of the Volcanic Beds and Cave Sandstone with the Rájmahál series of India (Middle? and Lower Jurassic), and of the Molteno beds with the Kota-Maleri series of India and the Wianamatta series of New South Wales (Rhætic).

Prof. A. Young described a remarkable case of an artesian well in the Karroo which shows a daily fluctuation in its discharge. The curve obtained during some weeks by a self-recording apparatus is very regular, and has a period of almost exactly $12\frac{1}{2}$ hours. The amplitude shows a marked variation, corresponding in time with the phases of the moon, and analogous to marine spring and neap tides. The outlet is more than 2700 feet above sea-level, and the author suggests that the water, which contains a large amount of inflammable gas, is forced up from a great depth through fissures by the pressure of natural gas, and that the observed fluctuation is a minor effect, due to the moon, superimposed on the effect of the constant gas-pressure. The phenomenon is scarcely affected by barometric changes.

At a joint meeting with the Geographical Section on the second day, Mr. H. C. Schunke-Hollway gave an account of the physical geography of Cape Colony. Mr. Rogers read a paper on Glacial periods in South Africa, in which he described the glacial deposits of Table Mountain Sandstone- (Silurian?) and of Dwyka- (Carboniferous) age, each formed of materials derived from the north. There is no satisfactory evidence of glacial action in later times, the glaciated forms of certain hills in Griqualand West, cited by Stow, being now known to have been produced at any rate not later than Dwyka times, since similar forms may be traced underneath the surrounding Dwyka conglomerate. They have been preserved by a thick covering of Dwyka and other beds, which have only recently been removed.

Prof. A. Penck (Vienna) contributed a paper on changes of climate as shown by variations of the snow-line and upper tree-limit since Tertiary times, in which, from a consideration of the geological evidence as to the relative height of the snow-line and tree-line in Glacial times, he drew conclusions as to the cause of the glacial conditions. The facts pointed to a lowering of temperature as the cause of the glaciation rather than to an increase of precipitation. Prof. Penck suggested that an examination of the higher parts of the Drakensberg might probably reveal traces of a Pleistocene Ice age in South Africa, though hitherto satisfactory evidence of this has been wanting.

Prof. W. M. Davis, of Harvard, brought forward evidence for the sculpture of mountains by glaciers.[1] He based his arguments principally upon the marked difference in form between valleys proved in other ways (*e.g.* by the presence of striations) to have been once glaciated, and those which have not been glaciated, the differences being in nature and distribution such as glaciers would cause on the assumption that they could erode.

Papers were also read by Prof. Sollas, on the continent of Africa in relation to the physical history of the earth; by Prof. J. Milne, on recent advances in seismology; by Mr. E. H. L. Schwarz, on "Baviaan's Kloof, a Contribution to the Study of Mountain Folds"; and by Mr. H. T. Ferrar, on the geology of South Victoria Land, giving the results of his observations on Antarctic rocks and glaciers made during the voyage of the *Discovery*.

Prof. Sollas sketched a possible way in which the present distribution of oceans and continents on the globe may have arisen. The earth is not strictly a spheroid, but resembles an ellipsoid, of which the shortest axis passes through the poles, while the longest lies in the plane of the equator and emerges in Central Africa. The distribution of land and water is such as would obtain if the earth had the form of a pear which had been somewhat compressed in the direction of its core, and thereby caused to bulge laterally. Africa would be situated on the broad end of the pear, and would represent the remains of the primeval continent—a supposition consistent with the known absence of marine sediments over the greater part of the interior, notwithstanding the thick accumulations of flat-bedded strata existing there.

Mr. Schwarz's paper contained an account of a remarkable piece of geological structure observed in the valley of the Baviaan's River, a tributary of the Gamtoos River, in the neighbourhood of Port Elizabeth. On the Baviaan's River occur certain outliers of Enon conglomerate (Cretaceous) which have been found by bore-holes to occupy steep-sided, basin-shaped depressions with no outlet, in Palæozoic rocks of the Bokkeveld and Witteberg series (Cape system). The basins are bounded by faults or steep dip-slopes, and are explained as having been formed by two series of cross-foldings trending E.S.E. to W.N.W. and N.E. to S.W., which took place while the country was covered with the Enon conglomerate, the latter being faulted down upwards of 1000 feet. The author objects to the usual explanation of rock-folding as produced by a direct tangential thrust against an obstacle, caused by shrinkage of the earth's crust, and suggests that it may in fact be gradually produced by earthquake-waves travelling through one kind of rock (say sedimentary beds resting on granite) and encountering a mass of rock having a different modulus of elasticity (as, for example, a boss of the underlying granite). The effect of this would be to heap up the strata in folds against the obstacle, somewhat as when waves break on the shore.

At Johannesburg a considerable number of the papers were, appropriately, of mineralogical and petrographical interest.

The proceedings opened with the delivery of the presidential address by Prof. Miers (Nature, August 24, vol. lxxii. p. 405).

Prof. J. W. Gregory followed with two papers of special interest to gold miners. In one of these, on the Rhodesian Banket, he stated that he had found during a recent examination of the district that the name had been applied to several different rocks which are locally auriferous—not only to an undoubtedly sedimentary conglomerate forming the main mass of the material, but also to crush-conglomerates and breccias, and to a diorite dyke with segregations of amphibolite. The Rhodesian conglomerate may probably be rightly called Banket, but differs considerably from the Banket of the Rand in its fluviatile origin, the greater variety in size and composition of the pebbles, and its probably greater age. The question as to the right of the Rhodesian deposit to the name of "Banket" aroused considerable discussion.

In his second paper (on the Indicators of the goldfield of Ballarat—a study in the formation of gold pockets) Prof. Gregory showed the secondary origin of the so-called "indicators," or thin iron-stained bands, which traverse the slaty country-rock of Ballarat and lead to rich pockets of gold at the points where they intersect the otherwise barren quartz reefs. The indicators are shown by microscopic and field evidence to be narrow seams of chlorite or rutile needles, which are not quite, though, as a rule, nearly, parallel to the bedding, and cannot therefore be of sedimentary origin.

Prof. R. Beck, of Freiberg, gave a summary of recent investigations on the origin of pegmatites as products of the crystallisation of the residual mother liquors of a solidified plutonic magma. Certain ore-veins have been formed thus as metalliferous pegmatites, for example the tin veins of Zinnwald and Embabaan, the copper ores of Telemarken and the auriferous quartz-reefs of Berezowsk, the Yukon district and Passagem, and other places in Brazil. The presence of tourmaline in certain gold-quartzes bears out this view of their origin.

Prof. A. P. Coleman, of Toronto, dealt with the magmatic segregation of sulphide ores. The recent complete mapping of the eruptive sheet with which the nickel-ore deposits of Sudbury (Ontario) are all connected, shows that the Sudbury ore is, like the pyrrhotite nickel ores of Norway described by Vogt, really a product of segregation from the rock, of which it forms an integral part with every gradation between ore and rock. Gravitation has probably played a large part in the segregation process.

Prof. Grenville A. J. Cole read a paper on marginal phenomena of granite domes, in which he upheld the view that banded gneissic rocks are due rather to the incorporation of the surrounding rocks with the materials of an invading granite than to simple dynamic metamorphism; the banding is produced by igneous flow, and is especially marked in cases where the absorbed rocks were sedimentary or already foliated.

On the second day Mr. G. W. Lamplugh gave his report of a journey, made under the auspices of the association to examine the zigzag gorge of the Zambesi

[1] The papers by Prof. Penck and Prof. Davis will be published shortly in the *Geographical Journal*.

below the Victoria Falls, from which he had just returned. Mr. Lamplugh, who penetrated down stream for a distance of 70 miles from the Falls, accepts and confirms the explanation given by Mr. Molyneux, of Bulawayo, who attributes the zigzags to the guidance of the stream-erosion by transverse joints in the basalt plateau through which the gorge has been cut.

Prof. Penck read a paper, illustrated by a fine series of lantern slides, on the Glacial deposits of the Alps.

Mr. Kynaston, director of the Geological Survey of the Transvaal, gave an account of the recent work of the survey. Since its re-organisation in 1903, the attention of the survey has been chiefly occupied with the later formations forming the central portion of the country, and the results obtained bear testimony to the able way in which the work has been carried on. The igneous complex of the Bushveld to the north of Pretoria may be mentioned as forming an interesting petrographical province. It illustrates the differentiation of a magma, in what is probably an enormous laccolite, intruded between the Pretoria and Waterberg series, into zones of increasing basicity, ranging from the red granite of the central region to the norites, pyroxenites, serpentine, and magnetite-rock of the margin.

Dr. F. H. Hatch explained the views arrived at by Dr. Corstorphine and himself as to the correlation between the pre-Karroo beds of the Transvaal and those of Cape Colony ("Geology of South Africa," 1905). Dr. Hatch also exhibited an instrument, devised by Mr. Oehmen, for surveying bore-holes, that is, for determining the amount and direction of the inclination of the bore-hole to the vertical at any given depth—a problem of considerable importance in a country where diamond drilling is so largely used as in South Africa, as a deep bore-hole may deviate as much as 30° or more in its lower levels.

The Rev. S. S. Dornan gave an account of his observations on the geology of Basutoland. The rocks belong to the Stormberg series, and consist of sandstones, mudstones, and shales forming the Molteno Beds and the overlying "Red Beds." Fossils are rare, but a few plant and reptile remains have been found in the former. Above the Red Beds lies the Cave Sandstone, a thick-bedded sandstone, which forms the crests of the hills and contains caves sometimes showing Bushman paintings. Reptile tracks are frequent, but few other fossils occur. The higher ridges of the Drakensberg and Maluti ranges are formed of lava-flows and intrusive sheets belonging to the volcanic series. This communication was of special interest on account of the difficulty of making observations and collecting fossils in Basutoland, as it is a native reserve, and the natives are unwilling to allow any prospecting, fearing lest they might lose their country should gold be discovered.

On the last day of the meeting Mr. C. B. Horwood read a description of the Dolomite formation, which is important as being practically the only source of underground water supply in the Transvaal. The rock is probably a deep-sea deposit, which has subsequently undergone dolomitisation in shallow water, and has lost in the process all trace of organic remains, so that its age is unknown. Mr. W. Anderson contributed a paper describing the first Tertiary rocks of marine origin which have been discovered in South Africa. These comprise sands, marls, and shales, with marine Mollusca (identified as probably of Eocene age) and Foraminifera in the upper beds, while in the lowermost shales occur numerous isolated bones of Mammalia (elephant, rhinoceros, hippopotamus, &c.), with water-worn fragments of fossil wood, and fish and crustacean remains. The beds, which are confined to the coast of Natal and Zululand, are probably of estuarine origin. A calcareous grit, forming the Bluff at Durban, is also probably Tertiary in age.

A paper by Mr. E. T. Mellor dealt with the evidences in the Transvaal of glacial conditions in Permo-Carboniferous times, and the distribution of the glacial conglomerates forming the base of the Karroo system, which corresponds to the Dwyka conglomerate of Cape Colony. Here, as in the country to the south, the striations, as well as the nature of the boulders, point to a northerly origin. Mr. Lamplugh read a note on the occurrence of Dwyka conglomerate at Kimberley Mine.

In a paper on the diamond pipes and fissures of South Africa, Mr. H. S. Harger expressed his view that the source of the diamond lay in a zone of ultra-basic rocks—eclogites, lherzolites, and pyroxenites—in which it may be an original constituent crystallising from the magma, for it has been frequently found in garnets and more rarely in olivine, and has been produced artificially in the latter. The blue ground filling the diamond pipes and the associated fissures is an altered breccia formed by the shattering of these ultra-basic diamondiferous rocks during a period of volcanic activity, probably in late Triassic or Jurassic times. Mr. Harger's paper was especially valuable as embodying the results of careful personal observations carried on through several years on the occurrence and associations of the diamond in the numerous mines scattered up and down the country, some of which are little known outside South Africa. An interesting collection of specimens of the associated minerals was on exhibition in the adjoining museum.

Papers were also communicated to the meeting by Dr. J. T. Carrick, on the geology of the West Rand; by Mr. F. P. Mennell, on the plutonic rocks and their relations to the crystalline schists; and by Mr. E. Heneage, on a consideration of the Archæan period of North America and South Africa with reference to mineral occurrences.

Apart from the papers read, a more than usual amount of interest attached this year to the geological excursions, of which a large and most interesting series were organised by Dr. Molengraaff, Prof. R. B. Young, and Mr. Rogers, to whom, with the other gentlemen who acted as leaders, the thanks of the section are especially due.

These excursions—many of which occupied several days and were on a scale hitherto unprecedented, except possibly at the Toronto meeting in 1897—afforded the members of the Geological Section a unique opportunity of seeing the most interesting features of the country under the guidance of the men by whom they had been investigated, members of the various surveys being spared for the purpose by their respective Governments.

After the meeting at Cape Town Mr. Rogers led a party through the Karroo, visiting, among much else of interest, the folded ranges of the Hex River district, and exposures of the Dwyka conglomerate (or Boulder-clay) and of the Beaufort beds which have yielded Pareiasaurus and other characteristic reptiles. While in Natal, several members visited the glaciated surfaces and overlying beds at Vryheid, under the guidance of Mr. W. Anderson, the Government geologist, and Dr. Molengraaff, formerly State geologist of the Transvaal. During the meeting in Johannesburg a number of afternoon excursions were made to the gold mines and other points of interest, while after its conclusion several more extended expeditions took place. These included one to Vereeniging, under Dr. Hatch, to examine the sandstones and coal-seams of the Ecca series, which have yielded the Glossopteris flora, and the associated beds, and to see Mr. T. N. Leslie's collections of fossil plants from the Ecca sandstone and of flint implements from the Vaal River. Another party had an opportunity of studying the norites and syenites of the Plutonic complex of the Bushveld, at the Pyramids and in the neighbourhood of the Pienaar's River, to the north of Pretoria, under Mr. Kynaston and Mr. A. L. Hall; while a third party, with Mr. Hall and Mr. Frames, visited the Duivels Kantoor, at the eastern edge of the Transvaal plateau, where the escarpment of the Black Reef series and Dolomite overlooks the floor of Archæan rocks, on the denuded surface of which they rest unconformably.

Excellent opportunities were also afforded of studying the occurrence of the diamond, both at the Premier and other Transvaal mines, under Mr. Cullinan, the chairman of the Premier Diamond Company, and Messrs. Hall, Harger, Kynaston, and Trevor, and at Kimberley through the kind offices of Mr. Gardner Williams, the chairman of De Beers.

In addition to this, there was a great deal of interest to the student of surface geology to be seen during the long train journey, among which may be mentioned the hill-country in the north of Natal, the flat and sandy bush-scenery along the line to the north, and the wonderful examples of weathering in the granite country of the Matopo Hills.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—Dr. Haldane, Fellow of New College, has been re-appointed lecturer in physiology on the nomination of the Waynflete professor. The appointment is for three years from January 1, 1906. Chemical physiology is the particular subject assigned to the lecturer.

The degree of M.A. has been conferred, by a decree of Convocation, on Dr. Schlich, secretary to the delegacy for superintending the instruction of Indian forestry students.

Cambridge.—An election to an Isaac Newton studentship will be held in the Lent term, 1906. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The studentship will be tenable for the term of three years from April 15, 1906. The emolument of the student will be 200*l.* per annum. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1906, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit.

An appointment to the Anthony Wilkin studentship in ethnology and archæology (*Reporter*, May 23, pp. 920–1) will be made in January, 1906. Applicants should send in their names, qualifications, and a statement of the research which they wish to undertake, to the Vice-Chancellor before January 1, 1906.

Mr. T. S. P. Strangeways, of St. John's College, has been re-appointed demonstrator of pathology for a period of five years from Michaelmas, 1905.

Prof. C. S. Sherrington, F.R.S., and Prof. R. Threlfall, F.R.S., have been elected honorary fellows at Gonville and Caius College.

The State Medicine Syndicate has nominated Mr. J. E. Purvis, Mr. G. H. F. Nuttall, Dr. J. Lane Notter, Dr. R. D. Sweeting, and Dr. A. Newsholme to be examiners in State medicine in the year 1906; and Mr. G. H. F. Nuttall, Mr. C. W. Daniels, and Prof. Ronald Ross, C.B., F.R.S., to be examiners for the diploma in tropical medicine and hygiene in the year 1906.

Dr. W. A. Bone, F.R.S., has been appointed professor of applied chemistry (fuel and metallurgy) in the University of Leeds.

Mr. Charles W. E. Leigh, formerly of the Natural History Museum, South Kensington, and late assistant secretary and librarian to the Manchester Literary and Philosophical Society, has been appointed librarian of the University of Manchester.

The following appointments, *Science* states, have been made in the faculties of the George Washington University:—General Henry L. Abbott, U.S.A., to be professor of hydraulic engineering; Dr. Edward B. Rosa to be professor of physics; and Brigadier-General George M. Sternberg, U.S.A., to be professor of preventive medicine.

We learn from *Science* that President Eliot, of Harvard University, has received a letter from President Pritchett, of the Massachusetts Institute of Technology, communicating the fact that, in view of the recent decision of the Supreme Court of the State in the case of John Wilson and others *v.* the Massachusetts Institute of Technology, the corporation of the institute find it impossible to proceed with the plan of cooperation between the university and the institute which has been under consideration for the past six months. The committee appointed by the Harvard board at the request of the institute has consequently been discharged.

At the annual general meeting of members of the Bedford College for Women, held on November 17, the chairman, the Right Hon. A. H. Dyke Acland, announced that the Parliamentary grant to Bedford College had for the current session been increased from 2000*l.* to 4000*l.* It was also reported that past students had already contributed 3500*l.* to the building fund. Principal T. G. Foster, of University College, and Lady Lockyer have been elected members of the council, as representatives of the senate of the University of London. The council offers two open scholarships of the value of 20*l.* each for one year for the course of secondary training beginning in January, 1906. The scholarships will be awarded to the best candidates holding a degree or equivalent in arts or science. Applications should reach the head of the training department not later than Monday, December 18.

Sir W. H. Preece distributed the prizes and certificates to the students of Birkbeck College on November 14, and afterwards delivered an address on the simplicity of science. Sir William Preece said he has never believed that in scientific and technical training Englishmen are far behind the rest of the world. However lacking we may have been in the upper regions of higher education, we have never failed to encourage education in other ranges, and Birkbeck College was one of the first in this country to spread the love of science and to offer educational facilities to those willing to use them in their leisure hours. What is wanted now, he continued, is that men who make fortunes in the metropolis shall become patriotic founders of endowments for enabling us to distribute the teaching advantages already existing to all classes of society. Sir W. Preece incidentally remarked on the absence of memorials to pioneers of science, mentioning especially Sir Henry Bessemer—an old student of Birkbeck College. Towards the conclusion of his address he suggested that Members of Parliament, before being permitted to legislate, should have to go through a course of instruction in scientific modes of thought.

At a dinner given by the Society of Apothecaries on November 14, Mr. John Tweedy, president of the Royal College of Surgeons, responding to the toast "The Royal Colleges of Physicians and Surgeons," dealt with the subject of medical education. He said that, in accordance with the promptings of the General Medical Council, the Royal College of Surgeons has raised the standard of general education of medical students, and has increased the multiplicity and severity of the examinations. But Mr. Tweedy would like to see the wheel turned back a little. He thinks that too much is being attempted in the way of examinations, and desires to see steps taken in the direction of simplification, without any sacrifice of efficiency. If some of the restrictions and regulations were relaxed, he believes a better class of practitioner than is possible under the present *régime* could be produced. The student is over-taught, over-examined, so that he has no time to reflect, to exercise his reason or his intellect. Mr. Tweedy believes that the medical examinations are best entrusted to professional corporations. Although he does not go so far as to advocate deprivation of the universities' power of granting qualifying degrees, he pointed out that the universities do not possess a qualifying degree in law.

SOCIETIES AND ACADEMIES.

London.

Royal Society, July 29.—"Studies on Enzyme Action. VII.—The Synthetic Action of Acids contrasted with that of Enzymes. Synthesis of Maltose and Isomaltose." By E. Frankland **Armstrong**. Communicated by Prof. H. E. Armstrong.

The belief has grown up of late years that the enzymes which are capable of inducing the hydrolysis of di-saccharides or bioses act reversibly; as yet, however, but little has been done to define the theory of the process, and no understanding has been arrived at as to the limitations to which such changes are subject. The same is true of the action of acids, which also act reversibly under certain conditions.

The key to the interpretation of the changes which attend condensation must be looked for in the behaviour of glucose itself in solution.

The term glucose, in fact, has a double connotation, and these two substances must usually be thought of under the single name. As crystallised from alcohol, it consists almost entirely of the α-form; but this changes over into the β-form if maintained during several days at about 105°. If either form be dissolved in water, change takes place of the one into the other; ultimately, the two forms

exist in solution in equilibrium, in proportions which depend on the conditions, the β-compound predominating. Change takes place in a similar manner in other media.

The process by which a monose is converted into a biose must be regarded as precisely similar to that by which α-glucose and β-glucose are converted into the two methylglucosides: the behaviour of maltose, in fact, is such as to characterise it unquestionably as glucose-α-glucoside; isomaltose is presumably the stereoisomeric glucose-β-glucoside.

When glucose undergoes condensation "uncontrolled," it should give rise to both maltose and isomaltose, the proportions of which ultimately present in equilibrium would depend on their relative stability under the conditions operative at the time. But, inasmuch as hydrolysis under the influence of enzymes is an absolutely selective process, being so controlled that it takes place in one direction only, it might be supposed that synthesis under their influence would also be a controlled operation, and that the tendency of the enzyme would be to reproduce the biose which it hydrolyses: apparently this point of view was present in Croft Hill's mind and led him to suppose, at first, that maltose was the actual product; as a matter of fact, it is uncertain at present whether maltose is produced at all: it is certainly not the sole or even the predominant product.

The formation under the influence of the enzyme of a single biose, *isomeric with that which it hydrolyses*, could be accounted for on the assumption that both are produced initially, but that the one again undergoes hydrolysis as soon as it is formed, so that it all but disappears.

Proof is given in the present communication that when the condensation is effected under laboratory conditions the action takes place in the manner indicated above; in other words, the two products required by theory are both formed. Evidence is adduced to show that isomaltose is the β-glucoside correlative with the α-glucoside maltose. Experiments are described bearing on the formation of isomaltose by the agency of the α-enzyme maltase and of its correlative maltose by the agency of the β-enzyme emulsin which leave little doubt that the two bioses are producible from glucose. Whilst it is left undecided whether maltase can give rise to maltose, evidence is cited which at least renders it probable that emulsin does not give rise to isomaltose.

"Studies on Enzyme Action.—Lipase." By Henry E. **Armstrong**, F.R.S.

The study of vegetable lipase is of special importance, as the ordinary fats which are hydrolysed under its influence with peculiar readiness—are not asymmetric material but simply glycerides of acids of the acetic or oleic series. The interest of the inquiry is enhanced by the fact that animal lipase, according to Dakin, acts selectively but the selective effect of lipase is of a different order from that displayed, for example, by an enzyme of the sucroclastic class, which can only attack one member of a pair of enantiomorphous isomerides.

In the course of the experiments, Connstein's contention has been confirmed that the presence of acid is necessary to condition the hydrolysis and that practically any acid is effective provided a sufficient amount be used. Aspartic and glutamic acids—which are formed at an early stage of the germination of seeds—were found to be highly active; glycin and asparagin, however, were practically without effect.

All attempts resulted in failure which were made to obtain an extract containing an enzyme, whether from the freshly-ground material directly or after this had been deprived of the fatty matter and whether or no acid were present. Apparently, acids do not act merely by liberating the enzyme.

The Ricinus enzyme has been found to have but little action, not only on ethylic butyrate, on acetin and on dimethylic tartrate and racemate but also on ethylic mandelate, which, according to Dakin, is readily attacked by animal lipase.

It is difficult to resist the impression that the differences observed are not merely consequences of differences in stability of the various ethereal salts but that the Ricinus enzyme is possessed of properties which make it specifically capable of promoting the hydrolysis of glycerides of the higher fatty acids.

Received August 10.—"Fertility in Scottish Sheep." By Dr. F. H. A. **Marshall**. Communicated by Prof. E. A. Schafer, F.R.S.

Received August 18.—"The Pressure of Explosions. Experiments on Solid and Gaseous Explosives." Parts i. and ii. By J. E. **Petavel**.

Part i. deals with the methods and apparatus used in the research. Part ii. is devoted to a study of the properties of cordite.

Received September 7.—"On the Nature of the Galvanotropic Irritability of Roots." By Dr. Alfred J. **Ewart** and Jessie S. **Bayliss**. Communicated by Francis Darwin, For.Sec.R.S.

After the contradictory experiments of Müller-Hettlingen, and Elfving, Brünchorst found that strong currents produced a positive, and weak currents a negative, curvature. Roots hence appeared to possess a parallelotropic irritability to electrical currents, reversible according to the intensity, as in the case of heliotactic and heliotropic irritability. The experiments were not altogether satisfactory, nor did they reveal the mode of stimulation, so further investigations seemed desirable.

These have shown that the curvatures are produced by the acid and alkaline products of electrolysis liberated on opposite sides of the root. The acid products are more effective than the alkaline, so that when the current is led transversely through the subapical sensitive region the curvature always takes place towards the positive electrode; but if one electrode is placed upon the hypocotyl and the other on the irritable zone, the curvature is always towards the latter electrode, whether it be positive or negative. These *galvanogenic* curvatures are hence chemotropic in origin, as has been shown by direct experiments with acids and alkalis. Thus, if the roots are imbedded at varying distances in gelatin through which a current is passed, the roots curve in regular order towards the electrodes shortly after the acid or alkali, as evidenced by phenolphthalein, has diffused near to them.

In addition, the application of the electrolysed region of a root or of filter paper moistened with decinormal acid or alkali produces similar curvatures.

All these curvatures have been produced on a klinostat and without any injury to the root. Indeed, in many cases a constant current of 0·000009 of an ampere is sufficient to cause a curvature. Using non-polarisable electrodes, no response is given unless very strong currents are used, since the stimulation is now dependent upon the restricted internal polarisation in the root.

It is doubtful whether the electrical currents in the soil call this special irritability regularly into play. The power of curving towards faintly acid or alkaline regions must aid the root greatly in reaching soil where soluble constituents are most likely to be abundant, or where anaërobic nitrogenous decomposition (with a production of ammonia) or the subsequent aërobic nitrification (with a production of traces of nitrous and nitric acids) are in progress.

The non-development of any power of curving away from strong acid or alkali is to be explained by the non-occurrence of high local concentrations in normal soil. Even when a strong local acidity or alkalinity is artificially produced in the soil, the roots are killed before they can curve away from it, and even if the apical zone did curve away, the non-curving zone behind would be rapidly killed.

Sociological Society, October 24.—Sir John Cockburn in the chair.—Biological foundations of sociology: Dr. G. Archdall **Reid**. The author outlined modern teaching on the subject of heredity, accepting the Weissmannian conclusion regarding the non-inheritance of acquired characters. These principles he applied to human qualities with especial reference to the possibilities of selective breeding. Four main conclusions were reached:—(*a*) That there is a confusion, in popular and in uncritical medical opinion, of variation with acquirement. Many individual acquirements are considered innate. (*b*) That racial

change through heredity is a process requiring very long periods of time, so increase of natural ability by selection of variations must remain, on the whole, inconsiderable. (*c*) That the more important factor is individual acquirement or education. The great output of genius during the Athenian and Renaissance periods is to be explained, not in terms of natural ability, but as arising from exceptional opportunity. (*d*) That the one practicable method of improving the racial average of natural ability is by the elimination of clearly degenerate types.

Challenger Society, October 25.—Mr. F. W. L. Holt in the chair.—Charts illustrating the physical conditions in the English Channel during 1903 and 1904: Dr. E. J. **Allen** and D. J. **Matthews.** The observations, which were conducted from the Plymouth laboratory of the Marine Biological Association as a centre, had been made by the association's steamers *Huxley* and *Oithona*, by ocean-going liners and cross-Channel steamers, and at lightships and lighthouses. They extended from about Dungeness to Cape Finisterre, and showed the north-easterly movement of oceanic water of high salinity and temperature, the southerly movement of water of low salinity from the Irish Sea, and the varying effects of these movements on the waters of the English Channel in different months.

Royal Astronomical Society, November 10.—Mr. W. H. Maw, president, in the chair.—Observations of the sixth and seventh satellites of Jupiter, from photographs taken at the Royal Observatory, Greenwich, with the 30-inch reflector of the Thompson equatorial: **Astronomer Royal.** The photographs were shown on the screen, with diagrams to illustrate the orbits of the satellites.—Observations of the satellite of Neptune, from photographs taken at the Royal Observatory, Greenwich, with the 26-inch refractor: **Astronomer Royal.**—Expedition to Vinaroz, on the east coast of Spain, to observe the total solar eclipse of August last: Father **Cortie.**—Eclipse expedition to Burgos: Mr. **Thwaites.**—Eclipse expedition to Labrador: Mr. **Maunder.**—Photograph of the partial phase of the recent eclipse showing distinctly the entire disc of the moon: Mr. **Saunder.**—(1) Secular acceleration of the earth's orbital motion; (2) Ptolemaic eclipses of the moon as recorded in the Almagest: Mr. **Cowell.** In a paper already printed the author showed that the ancient solar eclipses are satisfied by adopting the following secular terms:—(1) in the distance of the moon from the node $+4''.4$, and (2) in the distance of the moon from the sun $+6''.8$. He now showed that these conclusjons are supported by the eclipses of the moon as given in the Almagest. Mr. Cowell considered that a secular acceleration of the earth's orbital motion does not contravene gravitational theory, as Prof. Newcomb had suggested, since it might be ascribed to the resistance of the ether.—Other papers were taken as read.

Physical Society, November 10.—Dr. C. Chree, F.R.S., vice-president, in the chair.—The question of temperature and efficiency of thermal radiation: J. **Swinburne.** It has long been known that various surfaces have different emissivities, and it is generally held that at a given temperature some bodies radiate a larger percentage of their total radiation in the form of light. This view is largely based on some experiments by Evans and Bottomley, both of whom, the author remarks, make the same slip in confusing difference of emissivity with difference of efficiency at the same temperature. It is urged that a body A at the same temperature as B cannot give out radiation corresponding to a higher temperature of B, for if it could, and A and B were enclosed in a perfectly reflecting space, A would heat B to a higher temperature than A.—Note on constant-deviation prisms: T. H. **Blakesley.** It appears that any prism of three faces can be made to give a spectrum in which the light, that occupies the centre of the field of view of the telescope at any moment, has undergone passage through the two refracting surfaces of the prism in such a way that its original angle of incidence is equal to its final angle of emergence. This condition, which in the ordinary employment of the prism is associated with minimum deviation, must be described as isogonal passage, the property which has the minimum value being not the deviation, but the rate of passage across the field of view for a given motion of the prism, to which alone in these instruments motion has to be given to bring different parts of the spectrum into the field, the telescope and collimator both remaining fixed. If any triangle having the angles α, β, γ is adopted as the shape of a prism, the telescope must be set to make one of these angles, say γ, with the line of the collimator. Then the prism being placed in the region between them, a position can be found so that any ray selected will be refracted through one of the sides containing the angle γ, reflected at the side opposite γ, and finally refracted through the remaining side containing γ. On emergence it will be parallel to the telescope, and its passage through the refracting faces will be isogonal. The prism will affect the light to the same degree as one used in the ordinary way, of refracting angle $\beta-\alpha$, would do. The sine of the angle of original incidence is equal to $\mu . \sin(\beta-\alpha)/2$ for every ray occupying the centre of the field of view. If the prism is turned over, but the same angle γ employed, the telescope will remain unaltered, but the spectrum will run in an opposite direction to the first. Mr. Blakesley showed the case of two prisms in which the spectra ran in different directions. The top prism was slightly tilted by the insertion of a small piece of silver paper between the prisms. By this means one of the spectra was shifted upwards by a small amount, and one could see in the telescope a band, at top and bottom, of the component colours, and in the centre a band of the resulting colours. It was suggested that spectroscopes on this plan could be advantageously employed in measuring the motion in the line of sight of heavenly bodies, as a line brought into coincidence with itself for a terrestrial source in the two spectra would, in the case of such motion, split up into two moving *different* ways in the field of view. It was also explained how such prisms could be placed in trains for increased dispersion.

Royal Meteorological Society, November 15.—Mr. Richard Bentley, president, in the chair.—The rainstorm of August 24 to 26 in counties Dublin and Wicklow: Sir John W. **Moore.** The atmospheric disturbance which caused the torrential rainfall was near the shores of Kerry and Cornwall on August 24, and the next morning it was near the Scilly Islands. Thence it travelled slowly northwards up St. George's Channel, its centre passing near Dublin early on the morning of August 26. At this time the system suddenly changed its course, crossing the channel eastwards to Wales, and finally passing over central England and out to sea at the mouth of the Humber in a north-easterly direction. It appears that the rainfall on August 25 exceeded 3 inches at all stations in the counties Dublin and Wicklow, while it rose above 4 inches, and even 5 inches, at stations near the Dublin and Wicklow mountains. Sir John Moore is of opinion that this remarkable downpour was brought about by the cooperation of the following factors:—(1) a chill antecedent to the arrival of the rain-bearing depression; (2) the slow progress of the depression; (3) the fact that the counties Wicklow and Dublin lay to the westward of the cyclonic centre, and so received its north-easterly and northerly winds; and (4) the physical configuration of those counties and their coast line. As the result of this remarkable rainstorm a destructive flood occurred over the low-lying parts of the Bray urban district near the mouth of the Bray River. At Little Bray the water rose to a height of 4 feet in the streets, flooding houses, destroying domestic animals and fowls, wrecking furniture, and covering floors, yards, and gardens with a thick alluvial deposit.—The aquameter: Dr. W. B. **Newton.** This is a new instrument for measuring accurately the amount of aqueous vapour present in the atmosphere.

Paris.

Academy of Sciences, November 13.—M. Troost in the chair.—Nitrates and nitrites as manure: Th. **Schlœsing,** jun. Nitrate of calcium is now produced by electrical means from the air, and the salt thus obtained contains nitrite. It was desirable to ascertain whether the calcium nitrate is equivalent for manurial purposes to the sodium nitrate in ordinary use, and also whether the nitrite was in any way prejudicial. Cultivation experiments showed that the two nitrates were equivalent, and that the presence

of nitrite was without objection.—On the floating spiked Decapods collected by the American expeditions of the *Hassler* and the *Blake*: E. L. **Bouvier.**—On the congruences of skew cubics: M. **Stuyvaert.**—On the development of a uniform analytical function in an infinite product: M. **Zoretti.**—On the complementary geodesic triangulations of the upper regions of the French Alps (third expedition): P. **Helbronner.**—On a dynamometric brake designed for measuring the power of motors, and which allows of the utilisation, in an electrical form, of the greater part of the work developed: A. **Krebs.** This electrical brake has been successfully applied to measuring the horse-power of motor-car engines of from 1 horse-power to 200 horse-power. It has several advantages over the friction dynamometer, as it can be used as long as may be required without any danger of over-heating, and is not liable to the errors introduced by the variations in the coefficient of friction.—On the electrical phenomenon created in liquid chains, symmetrical as regards concentration, by the formation of a fresh surface of contact: H. **Chanoz.**—On the liquefaction of air by compression with external work: Georges **Claude.** A continuation of an earlier paper on the same subject, and giving an account of the modifications which it has been necessary to make in the arrangements of the apparatus to secure an increased yield of liquid air.—On the molecular conductivity of the phosphoric esters: P. **Carré.** Measurements are given for the monoalkylphosphoric esters derived from ethyl and isobutyl alcohols, glycerol, erythritol, and mannide, and it was found that the ionisation of the acid phosphoric esters is considerably greater than with phosphoric acid itself.—A general method for the synthesis of $\alpha\beta$-glycidic esters and of ketones: Georges **Darzens.** In a previous paper the author has shown that by the condensation of monochloroacetic acid with ketones, trisubstituted glycidic esters are formed by the saponification of which unstable acids are produced, the latter readily splitting up into carbon dioxide and a ketone. This reaction has now been extended to α-chloropropionic acid, giving ketones of the type $RR_1.CH-CO-CH_3$. The reaction appears to be quite general; eight new glycidic esters and five new ketones are described.—On the constitution of crystallised bodies: Fréd. **Wallerant.**—Observations relating to the morphology of aërial bulbs: Marcel **Dubard.** *Coleus Dazo* shows a tendency to accumulate its reserves in its aërial organs when the conditions of growth are unfavourable to the formation of subterranean stems. These reserves, of a starchy nature, are deposited in the axillary buds originally intended to form flowers.—The changes in the amount of fragrant oil present in the plant during the accomplishment of the functions of the flower: Eug. **Charabot** and Alex. **Hébert.**—Comparison of the cycles of evolution of the Orthonectidæ and Dicyemidæ: F. **Mesnil** and M. **Caullery.**—The formation of the vitellus in the sparrow: M. **Dubuisson.**—The embryogeny of the Hexactinidæ: L. **Faurot.**—The reason why certain deaf mutes can hear low notes better than high ones: M. **Marage.** From experiments on animals unprovided with any organ of hearing, the author concludes that the perception of low musical notes by deaf mutes is not hearing in the proper sense of the word, but a special sense for low notes which is also met with in the lower animals. The increase in the activity of the pancreatic secretion by calcium salts: C. **Delezenne.** The experiments described show the importance of calcium salts in developing the activity of pancreatic juice. A complete explanation of the effects produced is not, as yet, forthcoming.—On the tectonic at the S.W. of Chott and Hodna: J. **Savornin.**—On the use of hydrostatic pressure in tapping thermal springs: L. **De Launay.**—The exploration of the free atmosphere above the Atlantic Ocean, north of the tropical regions, on board the yacht of the Prince of Monaco, in 1905: H. **Hergesell.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—On the Nature of the Galvanotropic Irritability of Roots: Dr. A. J. Ewart and Miss Bayliss.—Some Observations on *Welwitschia mirabilis*, Hooker-f.: Prof. H. H. W. Pearson.—On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*; a Study in Relationship to the Causation of Malignant Disease: Prof. B. Moore, Dr. H. E. Roaf, and E. Whitley.—A Note on the Effect of Acid, Alkali, and Certain Indicators in Arresting or Otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*: E. Whitley.—On Certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics. A Contribution to the Chemistry of Anæsthesia. (Second Communication): Prof. B. Moore and Dr H. E. Roaf.—(1) On the Possibility of Determining the Presence or Absence of Tubercular Infection by the Examination of a Patient's Blood or Tissue Fluids: (2) On Spontaneous Phagocytosis and on the Phagocytosis which is obtained with the Heated Serum of Patients who have responded to Tubercular Infection, or as the Case may be to the Inoculation of a Tubercle Vaccine: Dr. A E Wright and Staff-Surgeon S. T Reid, R.N.—On the Occurrence of the Heterotypical Mitosis in Cancer: Dr. E. F. Bashford and J. A. Murray.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Applications of Electricity in the Royal Gun Factory, Woolwich Arsenal: Colonel H. C. L. Holden, R.A., F.R.S.

FRIDAY, NOVEMBER 24.

PHYSICAL SOCIETY, at 5.—The Dielectric Strength of Air: A. Russell.—On the Electrical Conductivity of Flames containing Salt Vapours for Rapidly Alternating Currents: Dr. H. A. Wilson.—On the Lateral Vibration of Loaded and Unloaded Bars: J. Morrow.

SATURDAY, NOVEMBER 25.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Report of Club's Delegate at Meeting of Corresponding Societies' Committee, British Association, 1905: F. W. Rudler, I.S.O.—Romance of Plant Life: F. Martin-Duncan.

MONDAY, NOVEMBER 27.

SOCIETY OF ARTS, at 8.—The Measurement of High Frequency Currents and Electric Waves; Prof. J. A. Fleming, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—Valuation by Select Tables: Separate Papers by Messrs. T. G. Ackland, O. F. Diver and G. King.

TUESDAY, NOVEMBER 28.

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: On Waterways in Great Britain: J. A. Saner.—*Also, time permitting*: The Steam-Turbine: The Hon. C. A. Parsons, C B., F.R.S., and G. G. Stoney.

WEDNESDAY, NOVEMBER 29.

SOCIETY OF ARTS, at 8.—The British Association in South Africa: Sir William H. Preece, K.C.B., F.R.S.

FRIDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Installation for the Bacterial Treatment of Sewage, at Neath: W. L. Jenkins.

CONTENTS.

THURSDAY, NOVEMBER 30, 1905.

LAGUERRE'S MATHEMATICAL PAPERS.

Œuvres de Laguerre. Tome ii. Pp. 715. (Paris: Gauthier-Villars, 1905.) Price 22 francs.

THE publication of the mathematical papers of Laguerre, undertaken after his death in 1886 by MM. Hermite, Poincaré, and Rouché under the auspices of the Academy of Sciences, has at length been completed. A first volume, to which M. Poincaré contributed as a preface an admirable appreciation of the author, appeared in 1898; and now some eighty papers which treat of geometrical subjects have been collected from the various scientific journals and reprinted in a second and final volume of more than 700 pages. Most of these papers are of but four or five pages in length, for it was Laguerre's habit, when a mathematical investigation had aroused his interest, to return to it again and again as new ideas occurred to him; and so it comes to pass that the majority of his writings on geometry may be classified as dealing with one or other of some half-dozen wide but distinct subjects.

The discovery with which Laguerre made his entry into the ranks of original investigators is of such moment in the history of modern mathematics that we will pause in order to realise the condition of geometrical knowledge at the time, and the circumstances in which it was made. The first three of the papers now under review bear the dates 1852–3, and were written when the author, a student eighteen years of age at the Institution Barbet, was still only a candidate for admission to the École Polytechnique. It was a time when a great change in geometrical thought had been initiated. Poncelet and Chasles had begun to build up the theory of projective geometry, and through it mathematicians had been made to recognise that theorems previously regarded as wholly without connection might in reality be but different presentments of the same more fundamental fact. But the structure was as yet very far from complete; many of the chief features of the theory as we now know it were still obscure and needed explanation. It fell to Laguerre to provide the most important and prolific discovery on which modern geometrical theory has been founded, the inner meaning of angular magnitude. In the second of his three early papers was enunciated for the first time the proposition that the sides of an angle form with the two isotropic lines through the vertex a pencil the anharmonic ratio of which depends only upon the magnitude of the angle.

This was no chance discovery, lighted on by a stroke of undeserved good fortune, for the rest of the paper shows how true a grasp of the new principles Laguerre had already obtained. He goes on to point out that the proposition furnishes the solution of the problem of homographic transformation of angular relations—a problem which had baffled the founders of projective geometry—and gives many further developments and results, a special case of one of which may be cited as illustrative. The well known theorem of Menelaus concerning the ratios of the segments into which the sides of a triangle are divided by any straight line is identical with the theorem that the angles of a triangle make up two right angles; either theorem can be deduced from the other. It is regrettable that English treatises upon analytical geometry so rarely attribute theorems to their authors, for it is with this discovery, rather than any achieved later in more advanced subjects, that we should wish the name of Laguerre to be always associated. Certainly no discovery has had so far-reaching an influence upon geometrical research during the past half-century.

In the twelve years which followed Laguerre published nothing. His military duties as an officer of artillery at first absorbed him; then, having been transferred to the manufactory of arms at Mutzig, he found leisure to take up once more his favourite study; it was not, however, until 1865, after his recall to Paris to the École Polytechnique, that he published the first of the series of original papers which he continued without intermission until his death.

A large number of these are concerned with analytical geometry, and through an interesting section of them runs an idea allied to his earlier work, the use of imaginaries in geometry. Thus in one of the first papers we find a full exposition of the theory of foci as extended from conics to plane curves of any class, and the distinction is drawn between ordinary foci and singular foci of a curve which passes through the circular points. Another such matter with which Laguerre frequently occupied himself, and which seems never to have received the attention it deserves, is the means of representing in a concrete manner the points of a plane or in space the coordinates of which are complex quantities. Imaginary values of the coordinates may satisfy the equation of a curve, and are then often spoken of as the coordinates of an imaginary point on the curve; cannot geometry suggest some mode of representing these points similar to that of Argand, which plays so important a part in the theory of equations involving a single variable? No solution could be satisfactory which varied with the coordinate-system employed. Laguerre's method was to represent a pair of points the coordinates of which are conjugate complex quantities by a real segment of a line, distinguishing the two imaginary points when necessary by the sense in which the segment is measured; the ends of the segment are the intersections of the lines which join the imaginary points to the circular points. Thus the line joining two real foci of a conic represents the two imaginary foci. It now becomes feasible to express the conditions of collinearity, &c., of imaginary points by properties of their representative segments. For points in space a similar procedure is adopted; a point the coordinates of which are complex is represented by a real circle, which must be described in a definite sense.

Having extended the notion of a focus to curves other than conics, it was natural that Laguerre should study curves which possess focal properties; accord

ingly he made many investigations upon special quartic curves, both plane and twisted; he considered the meaning of a focus of a curve traced on a sphere, showing that the method of inversion changed the ordinary foci of such a curve into foci of the inverse curve; he published many investigations upon a class of loci to which at the time considerable attention was paid, anallagmatic curves and surfaces. Other papers treat of the cyclide of Dupin, the curve of intersection of two quadric surfaces, and a family of curves called by Laguerre Cassinians: and it is to be noted that while writing upon a particular curve he would at times include theorems of wider application.

A passing mention may be accorded to an interesting statement of the addition theorem of hyperelliptic functions closely resembling that derived from Poncelet's polygons in elliptic functions; to researches upon Steiner's Roman surface and its reciprocal, known as Cayley's cubic surface, and other applications of the theory of forms to geometry. Finally, at the end of the book we meet with a series of papers in which Laguerre's discovery of *geometry of direction* is developed. The idea from which this sprang is elementary enough; a straight line or a circle may be traced out by a moving point in two opposite senses, and therefore is regarded by Laguerre as composed of two "half-lines" or two cycles. The notion of tangency is modified when a curve is described in a definite direction, so that a cycle is regarded as possessing one tangent only parallel to a given half-line. Following up this thought, Laguerre is led to divide all curves into curves of direction, which can be divided analytically into two trajectories traced out in different senses, and curves which have not this property; he finds the form of the tangential equation of the most general curve of direction. By help of a highly ingenious "transformation by reciprocal half-lines," it is shown how certain problems may be greatly simplified; the problem of drawing a circle to touch three given circles, for example, is reduced to that of drawing a circle through three points. The theory is extended also to spherical geometry.

Laguerre's life-work in geometry forms a volume which no mathematician can study without being profoundly impressed by the ingenuity of the author and his skill in handling every method which he employs; papers such as his, models of clear polished style, are read with keen intellectual enjoyment. Yet when the book is laid down and we reflect on the work as a whole, there comes a regretful conviction that what has been accomplished is very far from all that could have been hoped for from the powers of the author and his brilliant first achievement. Delicate in health and of retired life, Laguerre's isolation from the march of scientific thought is betrayed in his writings. General notions appealed to him solely by their applicability to particular problems, and he therefore chose to bestow the utmost care upon a number of short discussions of special topics. Let the reader, if he would appreciate what is best in these collected writings of Laguerre, realise when he takes up the book that its author was one of those who are content to apply to small things powers capable of far higher work, and he will find matter to arouse his interest and admiration in every paper reprinted in the volume.

PHILOSOPHICAL STUDIES.

(1) *Goethe's Philosophie aus seinen Werken.* Edited with an introduction, by Max Heynacher. Pp viii+428. (Leipzig: Dürr'sche Buchhandlung. 1905.) Price 3.60 marks.

(2) *Immanuel Kant, Physische Geographie.* Second edition. Edited by Paul Gedan. Pp. xxx+386. (Leipzig: Dürr'sche Buchhandlung, 1905.) Price 2.50 marks.

(3) *Dialoge uber naturliche Religion, über Selbstmord und Unsterblichkeit der Seele.* By David Hume Translated into German and edited by Dr. F Paulsen. Third edition. Pp. 165. (Leipzig. Dürr'sche Buchhandlung, 1905.) Price 1.50 marks

(4) *Immanuel Kant's Kleinere Schriften zur Logik und Metaphysik.* Second edition. Edited by Karl Vorländer. In four parts. Pp. xxxii+169, xl+172, xx+175, xxxi+176. (Leipzig: Dürr'sche Buchhandlung, 1905.) Price 5.20 marks.

(5) *G. W. F. Hegel, Encyclopädie der philosophischen Wissenschaften im Grundrisse.* Second edition. Edited by Georg Lasson. Pp. lxxvi + 522. (Leipzig: Dürr'sche Buchhandlung, 1905.) Price 3.60 marks.

(1) GOETHE'S work was so many-sided, and withal so voluminous, that it is a real service to educated thought to have presented, as here, a volume of extracts, in moderate compass, containing in his own words an account of the great writer's philosophic and scientific views, and of the influences exerted on him by different systems. Herder, Spinoza and Kant all obviously attracted him at various times, and his name must find a place in any account of the theory of colour or of comparative anatomy—to name only two of the scientific subjects in which he was interested. With these and kindred matters the editor deals in a well-informed introduction. He knows the literature well, his Eckermann, the Goethe Jahrbuch, and Goethe's poetry. Goethe's title to be regarded as a forerunner of Darwin is duly emphasised.

(2) That Kant should thus have lined the wings of his spirit in the dregs of the sensible world will astonish the average reader, for this work condescends to minute details regarding the animal, vegetable, and mineral kingdoms, the characteristics of different races of men, and the like. Even one of the earlier parts, dealing with mathematical preliminaries, is not at all speculative in its nature, and only one or two paragraphs in the introduction, which point out that geography deals with facts in space as history with events in time, remind us of the Critique of Pure Reason; but the services of Kant to geography are not negligible, and have been attested by Helmholtz.

The present edition contains a full statement of

variant readings, and many corrections of the text due to this editor.

(3) Hume's dialogues on natural religion run on much the usual lines. The characters are three in number, Demea the representative of believing scepticism, Philo of unbelieving scepticism, and Cleanthes of conciliatory rationalism. But there is this peculiarity in Hume's treatment, that, while there is no doubt that his own standpoint is that of Philo, he has chosen to make Cleanthes the hero, and concludes his work with the opinion that Philo's principles are more probable than Demea's, but that those of Cleanthes approach still nearer to the truth. The essays on suicide and on the immortality of the soul have been preserved only by accident, as their author attempted to suppress them. The German translation and introduction are from the pen of the well known professor in Berlin, and, like everything published in this philosophical series, are excellent.

(4) This volume contains about fifteen of Kant's smaller metaphysical and logical works, some of them translated from Latin, some of them written before the birth of the "critical" philosophy, not all of them interesting or important. They range over a variety of themes, from the dreams of a spiritist (viz. Swedenborg) to the well known prize-essay on the progress of metaphysic since the time of Leibniz and Wolf. This editor's introductions to the various essays and treatises are extremely helpful and interesting.

(5) The encyclopædia, the only complete and authentic statement of Hegel's system—best known to English readers by the late Prof. Wallace's translations of its first and third parts—is here published in an excellent form. In the introduction the editor discusses (*a*) the fundamental ideas of the Hegelian philosophy; (*b*) philosophy as science; (*c*) the encyclopædia, and Hegel's relation to earlier systems.

OUR BOOK SHELF.

The Oxford Geographies. Vol. ii. The Junior Geography. By A. J. Herbertson. Pp. 288. (Oxford: Clarendon Press, 1905.) Price 2*s*.

When a school-book treats of the geography of the whole world in less than 300 pages of large, clear print, interspersed with abundant diagrams, its claim to compete with the ordinary class-book must be based on the substitution of quality for quantity, wise selection and arrangement for all-including comprehensiveness. The book before us may fairly make such a claim. There is nothing of the gazetteer about it: its method is that of connected description; in place of statistical tables we have an abundance of distribution-maps, and continents and countries are divided according to physical features more than by political boundaries. Thus in the case of England the counties are entirely ignored, and the pupil is spared the necessity of learning as many "facts" about Oxfordshire as about Lancashire. So, too, in the case of Europe, there is a special section on Alpine lands, which renders possible a connected account of the railway routes across the Alps, and should prevent the common misconception of the Alps as coextensive with the political area of Switzerland.

Nearly one-third of the book is occupied with the British Isles, and about as much with Europe, the remainder being about equally divided between Asia, Africa *plus* Australia, and America. It would be easier to form a judgment on the opening part if the "Preliminary Geography," which is intended to precede it, had been published. As it stands, this opening part, consisting of a large number of distribution-maps (orographical, climatic, industrial, &c.) of the British Isles, with a discussion of their meaning and relations, is full of suggestiveness to the enthusiastic teacher, and in his hands is capable of expansion into a course of practical geography.

In such a book the critic can, of course, find plenty of missing "facts," though we have found remarkably few of first-rate importance. Several which we failed to find in the text turned up in the maps, which is just as well in view of the importance which the author attaches to the study of maps. ("Look at the map and notice . . ." is a constantly recurring phrase.) Chicago, it is true, appears to be only casually mentioned on p. 262, without any allusion to its unique geographical position with reference to the Mississippi basin and the great lakes; and along with the trans-Alpine routes to which we have already referred we should have expected to find some account of the longitudinal route of the Orient express. While the numerous diagram-maps form one of the best features of the book, their execution is unequal, the lettering on some being indistinct and the shading sometimes amateurish. In the map of the chief North American railways the names of the lines might be given as far as possible, and the route of the projected Grand Trunk Pacific continued to Port Simpson instead of ending at Winnipeg; while in Fig. 22 it seems unnecessary to distinguish part of the Scotch coal-fields merely because the coal is of Lower Carboniferous age.

A. M. D.

Organic Evolution. By C. W. Saleeby, M.D. Pp. 124. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s*. net.

Dr. Saleeby has written a little book on a great subject, and there is much to admire in his achievement. Without technicalities and with vivacious clearness he discusses the history of the idea of organic evolution, the so-called evidences which show the validity of the evolution-formula, the conditions of evolution (heredity and variation) and the factors in the process (natural and sexual selection), the evolution of plants, the history of the horse, the past and future evolution of man. And we can get all this for a shilling! The author writes in an unconventional chatty way, and is nothing if not up to date. He seems, however, to have written in hot haste, for he makes many slips. Perhaps it does not matter much that he speaks of Alfred Russel Wallace as being in 1858 "a young surgeon," but it is hard on the whale to have it said of him that his five "fingers, hand and all, are buried deep in blubber, and serve him no purpose whatever." Surely Dr. Saleeby's teacher, Sir William Turner, to whom he gracefully refers, will be rather shocked at this libel on the whale's flipper. Perhaps it does not matter much that a certain Matthew Hay (Patrick Matthew?) is credited with having conceived the idea of natural selection in the early years of the nineteenth century, but we are somewhat baffled by being twice told that while the hen has three and a half fingers, the embryo chick has *a five-fingered hand*. If we dissect the embryo we shall see this, we are told. We do not like Dr. Saleeby's version of the lineage of extinct forms "which continuously connect the horse of to-day with a five-toed ancestor," but we object still more to the statement that "the adult or fully-developed barnacle is far inferior to the larva, for it

is little more than a fixed fleshy stalk, upon which grows the body and its shell"—"a palpable case of what we call degeneration." If all degeneration were on the lines of the barnacle's life-history, it would be difficult to distinguish it from progress. We wish there had not been these and other blemishes in this sprightly and interesting little book, for it is sure to be popular. J. A. T.

Le Chauffage des Habitations par Calorifères. By M. Raymond Périssé. Pp. 173. (Paris: Gauthier-Villars et Fils, n.d.) Price $2\frac{1}{2}$ francs.

THIS little work is of a very practical nature; and although it appeals more particularly to the engineer and architect it may be read with advantage by the general reader, for it sets out, in a manner which is clear and easily intelligible to all, the advantages which accrue from the systems of heating dwellings by the various warming apparatus which are installed, not in the living rooms, but on the ground floor or in the basement. The advantages in the use of steam, hot-water, or hot-air apparatus, instead of fireplaces or stoves, are certainly real ones; for the house is more uniformly and better heated, at a less expense, trouble, and risk, and the apartments are not encumbered with the large stoves so generally seen on the Continent.

The advantages and disadvantages of the different systems are explained, and various applications of these systems are illustrated. The reader is also told how each may be best applied and regulated to meet the variable requirements as to heat, the different circumstances of the dwelling, the conditions of occupancy, and the like.

Auslese aus meiner Unterrichts- und Vorlesungs-praxis. By Dr. Hermann Schubert. Erster Band. Pp. 240. (Leipzig: G. J. Göschen, 1905.) Price 4 marks.

TEN chapters dealing with a variety of subjects—logarithms, cyclotomy, the theory of physical dimensions, systems of circles and spheres being the most important. The principal novelty is the treatment of logarithms (pp. 1–68), fair approximations being obtained by combining inequalities such as

$$-\log m+2\log(m+1)-\log(m+2)>0.$$

The method is quite elementary and very ingenious, but it has no practical value, and strikes one as being artificial. The chapter on dimensions (reprinted from the *Naturw. Wochenschr.*, 1895) is interesting, but not convincing; its essential feature is

$$[\text{mass}]=[\text{length}]^3[\text{time}]^{-2}.$$

Pangéométrie; ou Précis de Géométrie fondée sur une Théorie générale et rigoureuse des Parallèles. By N. J. Lobatschewsky. Réimpression facsimilé conforme à l'édition originale. Pp. 279–340, and list of errata. (Paris: A. Hermann, 1905.) Price 5 francs.

LOBATSCHEWSKY shares with the Bolyais the credit of founding the theory of non-Euclidean geometry, in which Euclid's axiom of parallels is not assumed to be true. His "Pangéométrie" was communicated to the mathematical faculty of the University of Kazan in 1855 on the occasion of his jubilee; this fact might well have been indicated in the present reprint. It is the author's last and most complete exposition of his theory, and mathematicians will be glad to have it in this accessible form, though, like other similar reprints, it is rather trying to the eyesight.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Bates-Müller Hypothesis of Mimicry: a Question of Historical Accuracy.

A PAPER dealing with the above subject, by the late Dr. A. S. Packard, has just been published in the *Proceedings of the American Philosophical Society* (vol. xliii., No. 178, p. 393), in which this well known entomologist endeavours to show that the markings of organisms ("pœcilogenesis") are "due to the physical rather than to the biological environment." I must leave it to others to consider how far the late author has established his case as against Bates, Fritz Müller, and those who have accepted the theories of mimicry associated with these names. My object in asking you to give space to this letter is to point out a distinct error which, if allowed to pass unchallenged, is likely to be accepted as a true statement of Darwin's views in the sense conveyed by the American writer.

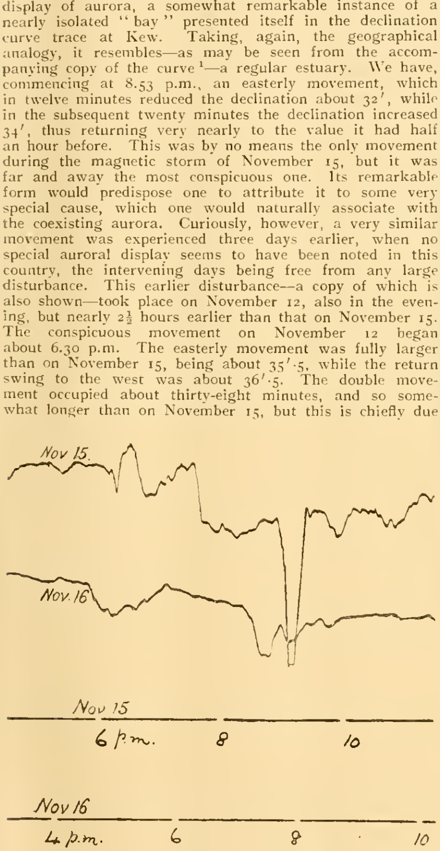
Happening to know the actual history of the Müllerian theory of mimicry through the courtesy of Mr. Darwin himself, I can assure those who read the paper that the passage which is quoted does not refer to that theory at all. In the letter to Fritz Müller referred to (August 28, 1870) Mr. Darwin says:—"I should not be at all surprised if your suggestion about sexual selection were to prove true; but it seems rather *too speculative to be introduced in my book*," &c. ("More Letters," vol. ii., p. 91). Now Dr. Packard quotes only the words which I have italicised as "Darwin's own estimate of Müller's little paper," but this is a misstatement of the facts. Darwin, it will be observed, is referring to a suggestion about sexual selection, and I am in a position to state what that suggestion was. At the date of the correspondence quoted (1870), Fritz Müller had observed the striking resemblances, or "mimicry," between butterflies belonging to "protected" groups, as, in fact, Bates had done before him. In searching for an explanation of this apparent violation of the Batesian theory, he suggested that it almost appeared as though the females of one protected species had been influenced in their choice by seeing the predominant pattern of other protected species always about them. Mr. Darwin was good enough to allow me to read Müller's letter to him, and in forwarding it to me in 1872 he added:—"You will also see in this letter a strange speculation, which I should not dare to publish, about the appreciation of certain colours being developed in those species which frequently behold other forms similarly ornamented" ("Charles Darwin," by E. B. Poulton, p. 202). This is the "suggestion about sexual selection" to which Darwin refers in his letter to Müller, and, so far as my memory serves me, I do not think this speculation was ever formally published to the scientific world.

The Müllerian theory which the late Dr. Packard considered that he had demolished was not published until 1879, the "little paper" in question having been contained in a number of *Kosmos* which Mr. Darwin forwarded to me in that year. On reading the said note I was at once convinced that Müller had found the true explanation of mimicry between protected groups, and I accordingly directed Mr. Darwin's attention to the matter and published a translation of the paper (*Proc. Ent. Soc.*, 1879, p. 20) in order to bring it under the notice of English entomologists. Writing to me in 1879 about this paper, Mr. Darwin said:—"F. Müller's view of the mutual protection was quite new to me" (Poulton, *loc. cit.*, p. 213). It is thus evident that Dr. Packard confused a tentative speculation of Müller's, which was contained only in a letter to Darwin, and probably never intended for publication, with the now well known Müllerian theory which was published formally some nine years later.

R. MELDOLA.

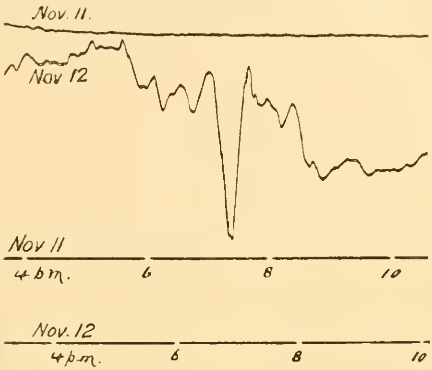
Magnetic Storms and Aurora.

IN view of the interest recently displayed in theories as to the origin of magnetic disturbances, attention may be directed to some rather curious phenomena exhibited during the magnetic storms experienced lately. Usually when a magnetic element during a storm suffers a large deviation in one direction it does not simply return to, but overshoots, its original value, and oscillates about its undisturbed position. If we liken the curve to the outline of an island on a map, a conspicuous indentation of the coast line is usually accompanied by a correspondingly pronounced promontory. Whilst this is much the more common phenomenon, it is by no means very unusual to have, as it were, an isolated bay in an otherwise straight coast line; only when this happens the "bay" seldom forms a deep indentation, and the curvature of its outline is seldom very great. On November 15, during the recent display of aurora, a somewhat remarkable instance of a nearly isolated "bay" presented itself in the declination curve trace at Kew. Taking, again, the geographical analogy, it resembles—as may be seen from the accompanying copy of the curve[1]—a regular estuary. We have, commencing at 8.53 p.m., an easterly movement, which in twelve minutes reduced the declination about 32′, while in the subsequent twenty minutes the declination increased 34′, thus returning very nearly to the value it had half an hour before. This was by no means the only movement during the magnetic storm of November 15, but it was far and away the most conspicuous one. Its remarkable form would predispose one to attribute it to some very special cause, which one would naturally associate with the coexisting aurora. Curiously, however, a very similar movement was experienced three days earlier, when no special auroral display seems to have been noted in this country, the intervening days being free from any large disturbance. This earlier disturbance—a copy of which is also shown—took place on November 12, also in the evening, but nearly $2\frac{1}{2}$ hours earlier than that on November 15. The conspicuous movement on November 12 began about 6.30 p.m. The easterly movement was fully larger than on November 15, being about 35′·5, while the return swing to the west was about 36′·5. The double movement occupied about thirty-eight minutes, and so somewhat longer than on November 15, but this is chiefly due



to the movement on November 12 beginning and ending somewhat less abruptly.

The total ranges of the declination disturbances on November 12 and 15 were respectively about 42′ and 50′. The other elements were also disturbed, the horizontal force range being approximately 200 γ on November 12 and 250 γ on November 15 ($1\gamma = 0{\cdot}00001$ C.G.S. unit). In each of these horizontal force curves there was also a prominent movement somewhat analogous to the above movements in the declination, but not synchronous with them, and with an *increase* of force. The horizontal force movement on November 12 was the more striking, the force increasing by about 180 γ in thirteen minutes, and



then falling off about 155 γ in the next thirteen minutes. On November 15 the nearest analogous movement was of a more normal character, an increase of 110 γ, occupying about ten minutes, being followed by a fall of 160 γ in the next twenty minutes. On November 12 the prominent horizontal force change was only a few minutes later than the prominent declination change, but on November 15 the most prominent horizontal force movement preceded the prominent declination movement by about $2\frac{3}{4}$ hours. There were considerable horizontal force movements at the time of the prominent declination movement on November 15, but they were of a more commonplace character. The disturbance on November 12 commenced about 9.30 a.m., terminating about midnight; that on November 15 lasted much longer, starting about 3.15 p.m., and continuing for about thirty hours.

CHARLES CHREE.

National Physical Laboratory, November 21.

[1] Two days' curves—each with its base line—are taken on each photographic sheet; the upper is always the earlier.

Absorption Spectra of Ultra-violet Rays by Vapour and Liquids

IN connection with some letters recently published in NATURE (vol. lxxii. pp. 557, 630), the following note may perhaps have some interest. Researches on the above named subject have been made in the physical institute of the University of Erlangen. Dr. Pauer (*Wied. Ann.*, lxi., p. 363, 1897) has determined for a great number of substances the position of the absorption bands, and Dr. Müller (Erlangen Inaugural Dissertation, 1903, *Sitzungsberichte der physikalisch-medicinischen Societat in Erlangen*, vol. xxxiv., p. 188, 1902) has tried to get some values of the absorption coefficients of vapours. By the researches of Friedrichs and Grebe, the results of Pauer have been in many respects amplified. Perhaps I may direct attention to the fact that Dr. Pauer found that the law of Kundt on the displacement of the absorption bands towards the red with increasing refraction index or dispersion is true when passing from the vapour to the liquid and then to the solutions in different media. His observations were made on benzol, toluol, the isomers of xylol and æthylbenzol, chlorobenzol, bromobenzol, iodobenzol, anilin, nitrobenzol, pyridine, bisulphide of carbon. Benzol and bisulphide of carbon were especially carefully treated by him.

Erlangen, November 13 E. WIEDEMANN.

The Second Law of Thermodynamics.

Is it not true that the Second Law of Thermodynamics is contradicted by the known facts of diffusion? When, for instance, masses of hydrogen and nitrogen are separated by a palladium partition, a difference of pressure is set up, owing to the diffusion of some of the hydrogen into the compartment which at first contained only nitrogen. In this condition the system is able to do work at the expense of its own heat, or heat entering from without. The palladium, in fact, takes the place of Clerk Maxwell's Sorting Demon, though, in this case, the process cannot be made continuous. M. A. BROWNE.

Christ's College, Cambridge, November 10.

BRITISH EXCAVATIONS IN THE NEAR EAST, 1904–5.

DURING the past year British archæologists have carried on the work of disinterring the remains of the ancient civilisations of Greece, Egypt, and Mesopotamia with energy. The excavations of the Trustees of the British Museum at Ephesus have resulted in interesting discoveries. The work was intended to supplement and complete that carried out under the auspices of the Trustees from forty to thirty years ago on the site of the Great Temple of Diana of the Ephesians. That work, carried out by the late Mr. J. T. Wood, resulted in the planning of the temple and the removal to England of many valuable antiquities now in the British Museum. The present work was entrusted by the trustees to the distinguished archæologist Mr. D. G. Hogarth. It has resulted in the discovery, undreamt of by Wood, of the remains of two earlier temples below that of the Crœsus temple, which he supposed to be the earliest, and of a vast number of votive objects of the eighth and seventh centuries B.C., among them many of gold and silver, besides Egyptian blue composition scarabs of the early twenty-sixth dynasty period. These were found underneath the second or "præ-Crœsus" temple. By the laws of Turkey, the antiquities, especially those of precious metal, must go to the Museum of Constantinople, but duplicates will come to the British Museum. Much new knowledge of the third or Crœsus temple, discovered by Wood, has also been gained. The two earlier ones seem to have been of interesting construction. Much heavy pumping work had to be carried out in the temple area, which had become filled with water. Mr. Hogarth is to be congratulated on having brought this interesting work to a successful conclusion.

On the mainland of Greece, Lakonia has been handed over by the Greek Government to the British School of Athens for excavations. Several minor discoveries of interest have been made, including that of a fifth-century local *heroön*, or hero-shrine, with its equipment of cultus-images, reliefs, figurines, and votive cups, &c., near Monemvasia. The work was carried out by Mr. R. C. Bosanquet, the Director of the School, and Mr. F. C. Hasluck.

The Cretan work of the British School has now been brought to a conclusion. The excavation of the site of Palaíkastro, in the province of Sitía, has not yet been completed, but is suspended, let us hope not for long. Mr. R. McG. Dawkins was in charge, and carried out his work most successfully under adverse conditions, owing to the now unhappily renewed troubles in the island, due to the fixed determination (whether it be right or wrong) of the Cretan people to effect their union with Greece. We can, parenthetically, only pray that Candia may not be the scene of riots, not for the sake of the Cretans, but for that of the museum, which contains all the trophies of the last few years' wonderful discoveries at Knossos and Phaistos, the destruction of which would be an irreparable loss to the whole civilised world.

This by the way. Mr. Dawkins's work has resulted in the discovery of the complete stratification of the temple site back to the first post-Neolithic age, and the discovery of fine pottery of the various stages of the Minoan period. It is evident that the later temple was built over the Minoan settlement, probably as the result of a survival of religious tradition in connection with the site. The exploration of the Minoan town has been regularly continued. In the hills near by Mr. Dawkins also discovered a Neolithic settlement with a very interesting deposit of twenty stone axes, "more than half of them in brand-new condition. This discovery gives us, for the first time in the Ægean, a definite idea of a Neolithic homestead."

The explorations of Messrs. Arthur Evans and Mackenzie at Knossos have been continued with the assistance of Mr. Doll as architect. By the kindness of Dr. Evans we are enabled to give a short sketch of the results of his work this season in advance. The chief work has been the exploration of the magazines on the paved way leading west from the "Stepped Theatral Area" (see NATURE, October 5). More stores of tablets relating to the royal chariots and armoury have been found, and a complete building excavated. On the hillside beyond the Candia road, the building to which the way led from the palace has been found and partly excavated. It proved to be a late Minoan house, larger than any other *dépendance* of the palace, and in it were found the remains of a shrine containing fetish images in the shape of natural stalagmite blocks of quasi-human form, together with a painted clay goat and other figures. Owing to heavy rainfall, the modern wooden pillars of the quadruple staircase in the main palace gave way, and Dr. Evans was obliged to rebuild the whole. This he did in more solid form with stone pillars of ancient shape and appearance. More interesting discoveries were made during the course of the work. We regret to learn that owing to absence of outside support for the Cretan Exploration Fund the Knossian excavations may shortly be brought to an end. It is evident that an excavator cannot go on bearing indefinitely the greater part of the cost of his excavations himself, as Dr. Evans has done. There is much more of the greatest importance to science to be found at Knossos, and we again appeal to those who are interested to subscribe to the Cretan Exploration Fund. There ought to be some money somewhere for the most important archæological exploration of the decade, which, despite the claims of Egyptian excavations, Dr. Evans's work must undoubtedly be admitted to be. We hope and confidently expect that, after a pause of a year or two devoted to the full publication of the momentous results hitherto obtained, Dr. Evans will be enabled to proceed afresh with the exploration of Knossos.

In Egypt the chief excavations of the year have been those of the Egypt Exploration Fund. The excavators employed by the fund were, as before, Profs. Naville and Petrie, and Messrs. Hall, Currelly, and Ayrton, Mr. Hall being lent, as last year, by the British Museum. To Messrs. Naville, Hall, and Ayrton was assigned the continuance of the excavations at Dêr el-Bahari, with the assistance of Mr. and Mrs. H. Garnett-Orme, who kindly gave their services to the Fund for this work. Messrs. Petrie and Currelly, with a party of helpers, among whom may be mentioned Captain Weill, of the French *génie*, were commissioned to investigate and clear

the well known temple of Sarábit el-Khadim, in the Sinaitic peninsula. Captain Weill has made the Egyptian inscriptions of Mount Sinai his special study.

The results of the first season's work on the eleventh dynasty temple at Dêr el-Bahari were described in NATURE, June 16, 1904; those of the second season have been equally interesting and important. The new temple is, in fact, the oldest now known at Thebes, and is the best preserved of the older temples of Egypt. It is the only temple of its period (about 2500 B.C.) known to us, and is therefore important as telling us previously unknown facts with regard to the architecture and art of that time. The temple is the funerary chapel of King Neb-hapet-Rā (formerly called "Neb-kheru-Rā") Mentuhetep, the first great Theban king. Last year's excavations were brought to an end when only a corner of the temple had been uncovered. Those of this year have resulted in the clearance of the main portion of it, leaving only the western end to be excavated this winter. It is a symmetrical rectangular building built upon an artificially levelled platform of rock. In the centre is a square erection which was apparently the base of a dummy pyramid of small size. Round this is an ambulatory or corridor of octagonal pillars, the outer wall of which was decorated with coloured reliefs. The platform was approached from the east on its centre line by an inclined plane or ramp, flanked by colonnades of square pillars on the lower level. This arrangement of platform, ramp, and flanking colonnades was apparently copied by the later architects of the temple of Queen Hatasu or Hatshepsut close by, which was excavated for the Egypt Exploration Fund by Prof. Naville, assisted by Mr. D. G. Hogarth and others, some years ago. The main arrangement of the old temple, with its central pyramid, &c., was not copied by Hatshepsut's architects.

A large number of fragments of the reliefs already mentioned have been found this year as last, and were exhibited at the annual exhibition of the Egypt Exploration Fund in the rooms of the Society of Biblical Archæology in July of this year. The brilliancy of their colouring and delicacy of their workmanship were remarkable, and they form an important addition to the chief known relics of Egyptian art. The carving of some of the sculptured hieroglyphs is of the finest style, which is not often seen in Europe, and was hardly known to many who had not visited Egypt and seen Abydos and Dêr el-Bahari.

Apart from the actual temple-buildings, the two most important discoveries were those of the sarcophagi of the priestesses of Hathor who were buried within the temple, and six portrait statues of the King Usertsen or Senusret III. of the twelfth dynasty, representing him at different periods of his life. The heads of two are missing. The portraits, especially the two oldest, are very fine. One of the white limestone sarcophagi is most beautifully carved with scenes of offerings being brought to the deceased priestess, of the cows of Hathor, &c. The sarcophagus and one of the statues are illustrated in an article on the temple by Mr. Hall in the August number of *Man*, from photographs taken by Mr. Ayrton.

The small votive offerings which were such a feature of last year's discoveries were not found in any quantity this year, but instead a much larger number of workmen's tools, hoes, baskets, mallets, &c., were found.

Prof. Petrie's work consisted in the clearance and planning of Sarábit el-Khadim and the study of the Wadi Maghara inscriptions. In the Wadi Maghara an inscription of the early King Sa-nekht, whose tomb was discovered by Mr. Garstang at Bêt Khallâf, in Upper Egypt, a few years ago, was found. The peculiarities of the plan of Sarábit el-Khadim had long been known, and now that they have been fully made out they appear sufficiently curious to demand some explanation, which Prof. Petrie has attempted to give. He explains the building as not primarily an Egyptian but a Semitic shrine, with *ḥanefiya* courts like those of a mosque, while the peculiar stelæ inscribed with records of Egyptian miners and the upright stones, which are such a feature of the place, he identifies as Semitic *bethels* or *baetyli*. Prof. Petrie also claimed this as the only Semitic temple known. His conclusions do not, however, seem to be altogether approved by other archæologists, and Mr. R. C. Thompson, of the British Museum, has criticised them in a recent article in *Man*, to which Prof. Petrie has replied, with the result of drawing a further reply from Mr. Thompson. The point about this being the only Semitic temple must undoubtedly be abandoned; the Babylonian temples are far older. That they are Sumerian is no argument against this, for the Semites took over most of their religious ideas from the Sumerians; but to an unprejudiced critic the weakest point of Prof. Petrie's argument seems to be the identification of the stelæ as *bethels*. If they were, they would, as Mr. Thompson says, be inscribed, not with mere records of Egyptian garrison and mining officials, with prayers to the Egyptian goddess Hathor, as they are, but with inscriptions of *Semitic* religious import, recording dreams and prophecies, &c. Prof. Robertson Smith's "Religion of the Semites" should be consulted on this point. The form of the stelæ is as Egyptian and non-Semitic as their inscriptions; we may compare with them the stela or obelisk of Usertsen I. at Begig, in the Fayyûm, and the two great stelæ in front of the funerary temple of King Sneferu at Mêdûm, discovered by Prof. Petrie himself in 1891.

A large number of interesting objects were brought back by the expedition, and were exhibited by the Egypt Exploration Fund at University College, Gower Street, in July.

Excavations have been carried on by Mr. Garstang for the University of Liverpool at Kom el-Ahmar, the site of the ancient Hierakonpolis, at Hissaya, south of Edfu, and at Esna. At Kom el-Ahmar Mr. Garstang found interesting remains of the third dynasty or earlier, at Hissaya graves of the Persian period, and at Esna a series of town-remains from Hyksos times until the twentieth dynasty. Two remarkable tomb-structures were found, of eight or ten chambers on the ground floor and a stairway leading up to the first floor, where there was a similar series. The site in general illustrated in an interesting fashion the provincial art of Egypt at the period. Excavation is to be resumed on it next year. We are indebted for these details to the kindness of Mr. Garstang.

In Mesopotamia the excavations of the British Museum at Kuyunjik, the site of Nineveh, have been brought to an end under the direction of Mr. R. C. Thompson, after the departure of Mr. L. W. King. The excavations have resulted in the discovery of many interesting buildings previously unknown, including a temple of the god Nabu and a new palace of Sennacherib. The planning of the whole mound of Kuyunjik and its ruins has been carried out to its completion. Messrs. King and Thompson also visited the rock of Behistun or Bisutun in Persia, and re-copied the famous historical inscription of Darius, originally copied by Rawlinson. The text obtained by them will be the

most complete and authoritative existing. Messrs. King and Thompson have also taken some unique photographs of the monument.

In the Sudan, Dr. Budge, of the British Museum, and Mr. J. W. Crowfoot, Inspector of Education in the Sudan, have completed the work which the former began at Meroe in 1903. They finally cleared out the shrine of the largest pyramid, and made some interesting explorations in the country near the Second Cataract. Dr. Budge, whose services had been previously lent to the Sudan Government by the British Museum in 1897, 1899, and 1903, is now engaged on an account of his four missions to that country, which is announced to appear in the spring.

We cannot close this account of British archæological work without a word of congratulation to our American friends on the success of the excavations of Mr. Theodore N. Davis, assisted by Mr. J. E. Quibell, the British Inspector of Antiquities in Upper Egypt, in the Valley of the Tombs of the Kings at Thebes. Mr. Davis found the untouched tomb of Iuaa and Tuaa, the father and mother of the great Queen Tyi, consort of Amenhetep III. and mother of the heretic King Akhunaten. The tomb was full of the most magnificent furniture, chariots, &c., mostly thickly overlaid with gold. Mr. Davis will proceed with his excavations this winter with the assistance of Mr. Ayrton, who has left the Egypt Exploration Fund for this purpose.

THE BEAUTY OF MINUTE STRUCTURE IN NATURE.[1]

ONE of the many ways of beginning the study of natural science is with a "beauty-feast"—of flowers or birds, of shells or gems, of anything—for all natural things are beautiful, in their proper setting at least. It is an old-fashioned mode of approach, commending itself to children and simple minds, but one which often leads far beyond æsthetic pleasure to the joy of understanding. It affords a dynamic to investigation, and fosters a healthy reverence for things. In school "nature-study" the æsthetic factor should be characteristic, though it is too often conspicuous by its absence. Indeed, if we had to choose, we should prefer admiration without science to science without admiration. But a simple book like that before us shows that there is no necessary antithesis; it is a disclosure of beautiful things, and yet within its limits it is quite scientific.

The author's aim is to illustrate by well chosen examples the beauty of minute structure, the beauty which the microscope discloses, and he is to be congratulated on his success. While older books on "the wonders of the microscope" had to be content with drawings, some of which were exquisitely done, this book presents us with photomicrographs of the highest excellence. It is difficult to over-praise them. Moreover, while the older books gave too much prominence to curiosities and out-of-the-way objects, we are here brought into close quarters with the familiar, with diatoms and Foraminifera, the whelk's radula and the barnacle's cirri, the butterfly's "tongue" and the scales of the sole, the spine of the sea-urchin and the spider's foot, a gnat and a house-fly's eggs, the dodder entering the clover, the bud of the lily flower, the sting of the nettle and the stem of wheat, and so on through a long list. Along with each of the sixty-five illustrations there is a short and clear description, and a note of the conditions of the photograph, *e.g.* magnification, focal distance, and exposure. The photographs were taken by Mr. Arthur E. Smith, and are certainly among the finest that have ever been published. They were taken, for

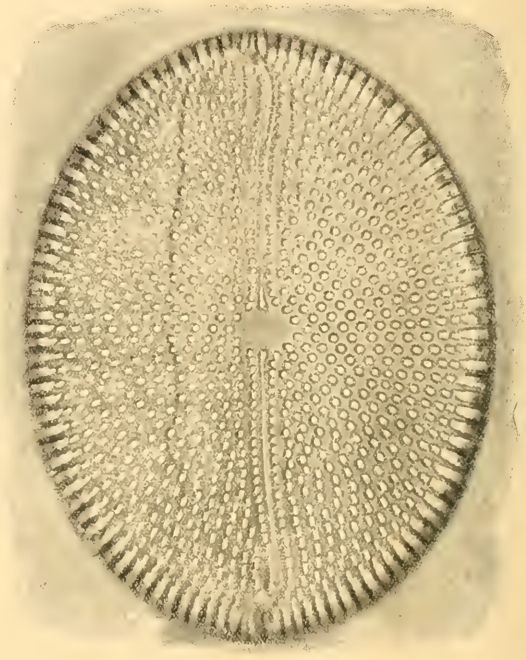


FIG. 1.—Diatom, from Bori, Hungary, × 1000. From "Nature through Microscope and Camera."

the most part, on 12 by 10 plates, and have been somewhat reduced in the process blocks. Mr. Smith contributes a useful chapter of practical hints on photomicrography.

Mr. Kerr is an enthusiastic photographer, who believes in his "intellectual pastime" as helping, indirectly, to remedy some of the ills we are heir to, such as "the amusement fetich." But he is more, he is a student of the beautiful things which he delights in, and he can tell their story in a plain, straightforward way. The moral that adorns his tale is expounded by Prof. G. Sims Woodhead in a finely conceived introduction; but we shall only say this, that the whole spirit of this beautiful book is well

[1] "Nature through Microscope and Camera." By Richard Kerr; with 65 photomicrographs by Arthur E. Smith. Pp. 197. (London: Religious Tract Society, 1905.) Price 6s net.

expressed in the prefatory quotation from Sir J. F. W. Herschel:—"To the Natural Philosopher there is no natural object that is unimportant or trifling; from the least of Nature's works he may learn the greatest lessons." J. A. T.

THE WASTAGE IN ARMIES BY DISEASE.

THE recent utterances of Sir Frederick Treves on the subject of the Army Medical Service (see NATURE, November 2, p. 15), and the discussion on enteric fever in the army which has appeared in the columns of the *Times*, have again directed attention to the inadequacy of the means taken in our army to prevent the incidence of enteric fever and other filth diseases. The crux of the matter is this: we have to provide hospital accommodation for 10 per cent. of our forces in the field, the Japanese for but 2 per cent. Why this difference? In the South African campaign no less than 746 per 1000 of the fighting forces were admitted into hospital for disease which is mainly preventable. In this war there were something like 450,000 admissions to hospital on account of sickness and some 22,000 admissions on account of wounds or injuries received in action.

"Among those admitted to hospital on account of disease alone, there were 14,800 deaths during the whole war; further, so far as can be estimated at present, 42,741 of the total admissions to hospital on account of disease, and 7998 of the deaths from disease, were due to enteric fever, while 31,363 of the admissions and 1248 of the deaths were from dysentery. In other words, no less than one-tenth of the admissions on account of disease were for enteric fever, and one-fourteenth were for dystentery, or these two diseases alone were the cause of practically one-sixth of the total admissions and about two-thirds of the total deaths on account of disease; these two diseases also accounted for nearly one-half of the total losses by death from all causes during the war. As we know that both enteric and dysentery belong to the group of diseases which are largely the outcome of faulty environment, the sanitary significance of these figures needs no argument."[1]

How does the Japanese Army deal with the prevention of disease? The following record sufficiently answers this question:—

"The care of the sick and wounded occupied but a small share of the time of the medical officers. The solution of the greater problem of preventing disease by the careful supervision of the smallest details of subsistence, clothing and shelter was their first and most important duty. Nothing was too small to escape their vigilance, nor too tedious to weary their patience, and everywhere, in the field with the scouts or in the base hospitals at home, the one prevailing idea was the prevention of disease. The medical officer was to be found both in the front and in the rear. He was with the first screen of scouts, with his microscopes and chemicals, testing and labelling wells, so that the army which followed should drink no contaminated water. When scouts reached a town, he immediately made a thorough examination of the sanitary conditions, and if cases of contagious or infectious disease were found, he put a cordon around the quarter where they were. A medical officer accompanied foraging parties, and, with the commissariat officers, sampled the various food, fruit, and vegetables sold by the natives before the arrival of the army. If the food were tainted, or the fruit over-ripe, or if the water required boiling, notices to that effect were posted in suitable places. So strict was the discipline from commanding officer to rank and file that obedience to the orders of the medical officer was absolute. The medical officer also supervised the personal hygiene of the camp. He taught the men how to cook, how to bathe, how to cleanse the finger nails so as to free them from bacteria, as well as how to live in general a healthy, vigorous life, and it was a part of the soldier's routine to carry out these instructions in every particular. As a result of this system the medical officer was not obliged to treat cases of dysentery and fevers that follow the use of improper food and the neglect of sanitation. During six months of terrible fighting and exposure in a foreign country there was only a fraction of 1 per cent. of loss from preventable disease."[1]

It may be true that vehicles other than water, particularly dust and flies, convey the infection in enteric fever, diarrhœa, and dysentery, but much can be done by safeguarding the water supplies.

Diminish the incidence of these diseases by any means whatever and the subsequent incidence of the disease will naturally be lessened—cases beget cases.

It may or may not be practicable to sterilise the drinking water for a big army in the field, but in camps and in small campaigns such as our "little wars" on the Indian frontier, and in Africa, a great deal more could be done than has been done. Thus in the Tochi Valley, in 1897, a force of some 4000 men was condemned to inactivity and suffered severely from diarrhœa, dysentery, and enteric. The British troops averaged an *annual* strength of 622, and among them there were 59 cases of enteric with 30 deaths, 371 cases of dysentery with 65 deaths, and 211 cases of diarrhœa with 10 deaths. Here was an ideal instance in which sterilisation of the water or distillation for the sick (as the water was very saline) could have been carried out, as there was plenty of fuel, and the extra cost involved would probably have been more than covered by the saving in pensions, &c. Lieut. Nesfield, I.M.S., in the Tibet campaign used his iodide iodate tablets (see NATURE, July 27, p. 303, and August 31, p. 432), with the result that of 700 men who drank water sterilised with them, none contracted cholera, while of other batches of men passing through the same region a few days later an average of 3 per cent. contracted cholera.

There can be no question that the medical officers of our army are a devoted body of men, highly trained, and fully alive to what should be done, but they are too few adequately to cope with the problem of prevention, and what is more they receive little encouragement in this direction from those in authority. In addition, a body of intelligent trained non-commissioned officers and men, a sanitary corps, is required to carry out the policy of the medical officers. At present guards for the water supply and similar purposes are drawn from the ordinary strength of the regiments, with, of course, no special training. In the China Relief Expedition in 1900 the Japanese provided three skilled men to take care of their sick and wounded for every two provided by the other armies. In olden times it was thought cheaper to obtain a new soldier than to cure a sick or wounded one; the reverse is the case nowadays if the authorities would but appreciate it, and prevention is even better than cure. R. T. HEWLETT.

NOTES.

WE announce with deep regret that Sir J. S. Burdon Sanderson, Bart., F.R.S., late Regius professor of medicine in the University of Oxford, died at Oxford on November 23.

PROF. EMIL WARBURG, president of the Reichsanstalt in Charlottenburg, and Prof. Henri Moissan, of the University of Paris, have been elected corresponding members of the Academy of Sciences of München.

THE twenty-first anniversary of the Royal Scottish Geographical Society was celebrated by a dinner in Edinburgh on Monday, November 27. Prof. J. Geikie, the president of the society, presided.

[1] Lieut.-Col Firth, R.A.M.C., *Journ. of Hygiene*, Sept., 1905, p. 543.

[1] *Brit. Med. Journ.*, 1904, ii. p. 1332.

THE death is announced of Dr. James Monckman on November 18, at the age of sixty-three. In 1879, after acting as honorary assistant to Prof. J. J. Thomson at Cambridge, Dr. Monckman received the degree of D.Sc. of London University. At Bradford he acted occasionally as consulting analytical chemist, and he carried out some researches in chemistry, as well as work in geology and botany. He assisted in the formation of the Bradford Scientific Society, and was thrice elected its president.

A DISTINCT earth tremor occurred in Manchester and Salford about 3.45 a.m. on November 25. Many people dwelling on the north-west side of the city and borough reported that they were disturbed from sleep by violent shaking of their rooms and the ringing of bells. Some persons reported that they heard a loud thud; others that there was nothing but one violent shock, followed by a tremor lasting several minutes. In the Seedley district of Salford some chimney stacks were displaced, but there was no other damage.

DR. F. AMEGHINO seems to be impressed with the idea that Argentina is the "centre of the universe," and that almost every group of mammals may be traced back to a South American ancestor. In the third of three papers dealing with the presence of a perforation in the astragalus of several groups of mammals, published in vol. xiii. of the *Anales* of the National Museum of Buenos Aires, he gives, for instance, a phylogeny in which both pangolins (Manidæ) and aard-varks (Orycteropodidæ) are placed as being derived from armadillos (Dasypodidæ). A more unsound pedigree it would be almost impossible to invent. Dr. Ameghino has detected the above-mentioned foramen not only in Orycteropus, but also in Canis, Typotherium, and certain mammals from the Middle Miocene of France.

AMONG the contents of the November issue of the *Naturalist* is a communication by Mr. A. Whitaker on the breeding habits of British bats. Unfortunately, the author's attempts to rear bats in captivity have been only partially successful, in some degree owing to the circumstance that it was not ascertained until too late that a female specimen was pregnant. One noctule bat gave birth, however, to an offspring almost immediately following its capture, and it was noticed that the squeak of the "baby" was even more high-pitched than that of its mother. When the young one was eleven days old (and still blind and naked) the parent escaped, but apparently returned and carried away her offspring. Neolithic remains from the Durham caves form the subject of a paper by Mr. C. T. Trechmann in the same issue.

ACCORDING to *Museum News*, No. 4, the Brooklyn Museum, which is in the van of progress, has been trying the experiment of placing, for the use of visitors, books relating to the subject of the specimens exhibited on tables alongside the various cases. So far the experiment seems to have been a decided success, but whether it could be repeated in this country may be doubtful. Apropos of descriptive labels in museums, it is stated in the same periodical that if ninety-nine objects are labelled and the hundredth is not so treated, visitors will pass over all the former and inquire for the label for the latter. Again, a visitor has been known to look at a label some six feet long, inscribed in letters three inches high "Atlantic Right Whale," and then turn round and ask the nearest official "what that animal is called"!

No. 25 of the "North American Fauna," issued by the U.S. Department of Agriculture, consists of an account of the biological survey of Texas which has been recently carried out. This part, which is by Mr. V. Bailey, deals, however, only with the determination of life-zones, and the reptiles and mammals, the birds being reserved for a future issue. The economical aspect of the subject has claimed a large share of the attention of the workers, especially as regards the suitability or otherwise of particular crops to particular climatic zones. The mapping of these zones—which are necessarily also life-zones—cannot fail to be of advantage to agriculturists, for "as a crop becomes an established success in one locality, a study of the zone-map will show over what adjoining county it can be profitably extended." Of the nine new mammals described, all but one are subspecies, thus showing how thoroughly the country has been worked.

DR. FORSYTH MAJOR has favoured us with a copy of an interesting and important paper from the October and November numbers of the *Geological Magazine* on certain rodents from the Pleistocene of the western Mediterranean countries. He first of all deals with the picas, or "mouse-hares," of the extinct genus Prolagus, which, instead of being confined to Sardinia and Corsica, is also continental, and extends as far west as Spain. Next it is shown that Hensel's *Mus orthodon*, which has been supposed, apparently owing to a misconception, to be akin to *M. sylvaticus*, represents a genus—Rhagamys—by itself. It has, for instance, tall-crowned molars with very thick enamel, and nearly vertical tubercles, which when worn present a characteristic pattern. Finally, the Pleistocene *Arvicola henseli* is shown to form a kind of connecting link between the Pliocene Mimomys, in which the molars are rooted, and modern voles, the dentine surfaces of the prisms of the latter being incompletely separated.

RECENT miscellaneous results of the work of the U.S. Bureau of Entomology are summarised in Bulletin No. 54 of that section of the Agricultural Department. One article is devoted to the sugar-cane beetle (*Ligyrus rugiceps*), on which a special investigation was undertaken last year, owing to the fact that the insect, and the best means of checking its ravages, had received practically no attention for the last five-and-twenty years. It is hoped that the remedies suggested will be found efficient by southern planters. "Conchuella," a Mexican cotton-pest, which it is feared may spread to Texas, has also received attention at the hands of the bureau's officers, while the demonstration of the efficiency of cold storage for "cow peas" (so largely used as fodder and for the improvement of the soil in the States) as a protection against the attacks of the three species of weevils to which they are subject may be regarded as a triumph for the bureau.

WE have received from the trustees a copy of "A Guide to the Fossil Reptiles, Amphibians, and Fishes in the Department of Geology and Palæontology in the British Museum (Natural History), Cromwell Road," issued at the price of sixpence. Although on the title-page merely stated to be the "eighth edition," this excellent little handbook has been entirely re-written by Dr. A. Smith Woodward, the keeper of the department, whose name is a sufficient guarantee that it is thoroughly up to date, and at the same time lucidly and simply written. In its new form it constitutes a brief, popular introduction to the study of the extinct representatives of the groups to which it is devoted. The most striking illustration is one of Mr. Carnegie's dinosaur, Diplodocus, which from considerations of space has been mounted in the gallery mainly devoted to recent reptiles, instead of among its fellow monsters. The plate of the skulls of two of the wonderful extinct horned tortoises—one from Queensland and the other from Patagonia—likewise merits a word of commendation.

MR. WINSLOW AND MISS ROGERS have suggested a new classification of the bacterial family Coccaceæ (*Science*, xxi., No. 539, p. 669). The family is divided into two subfamilies, the Paracoccaceæ and Metacoccaceæ, the former being subdivided into two genera, Diplococcus and Streptococcus, the latter into three genera, Micrococcus, Sarcina, and Ascococcus. We are not sure that this revised classification is a material improvement on the classifications which already exist. For instance, the Pneumococcus is included among the Diplococci, but culturally it is unquestionably a short Streptococcus, and in the sputum may occur in chains of four elements.

ALTHOUGH yams, the tubers of species of Dioscorea, are extensively cultivated in the West Indies and the tropics of South America for domestic consumption, their value as a food does not appeal to the Ceylonese, who show a preference for the less tasty and less nutritious imported potato. In the Circulars (vol. iii., No. 1) of the Royal Botanic Gardens, Ceylon, Mr. H. F. Macmillan has written some notes on Dioscoreas with the object of directing attention to their value as a vegetable, and also to assist cultivators in identifying the different varieties.

THE members of the Scottish Antarctic Expedition were prevented by stress of weather from making a complete exploration of Gough Island, so that the collection of plants obtained by Mr. R. W. Brown, and described in vol. xxxvii. of the *Journal of the Linnean Society*, is probably incomplete. Of the phanerogams and ferns, numbering twenty-seven, the most conspicuous were *Phylica nitida*, a tree characteristic of the Tristan da Cunha group, tussac-grass, *Spartina arundinacea*, and the tree fern *Lomaria Boryana*. The flora is very similar to that of Tristan da Cunha, but two endemic species, a Cotula and an Asplenium, were obtained.

AT the recent Colonial Exhibition held in the Crystal Palace, of the West Indian colonies Jamaica took the foremost place, receiving, amongst other distinctions, the gold medal presented by the West Indian Cable Company for the best collective exhibit. Of Jamaica produce, oranges and bananas are both much in evidence; the sugar and rum industries are prospering, while the cultivation of cacao, rubber, cotton, and tobacco are all more or less suited to the climate. In the *Agricultural News* (October 7) mention is also made of a tea plantation of 90 acres that promises well under the careful management of the owner, Mr. H. E. Cox. This and a plantation in Carolina, U.S.A., are said to be the only tea plantations in the western hemisphere.

MR. D. E. HUTCHINS, conservator of forests, Cape Town, presents an admirable survey of the past history and present condition of forestry in South Africa in the recent record of "Science in South Africa." The institution of a forest department in Cape Colony dates from 1881; since that time three-quarters of a million pounds has been expended, and the staff now numbers no less than 110 conservators and foresters. Yellow-wood furnished by two species of Podocarpus, the most widely spread indigenous timber trees, is not so valuable as the Clanwilliam cedar, *Callitris arborea*, which takes the place of Baltic pine; this cedar having been cut out in the past, future supply is dependent upon the timber that is now being raised in the Cedarberg country. Of exotic trees, species of Eucalyptus and Cupressus have been largely introduced for timber, and wattles for the production of tan bark.

NEARLY all parts of the British Islands experienced very severe southerly and south-westerly gales on Sunday last, November 26, which, in connection with the spring tides, occasioned great damage, especially on the west and south coasts, many houses being flooded, while the service in the English Channel was quite disorganised. The weather report issued by the Meteorological Office on Saturday morning notified the approach of an important depression off the coast of Ireland, and the chart for Sunday morning showed that the centre of the storm had already reached the west coast of that country, and that the barometer had fallen 0·7 inch in the last twenty-four hours. In the north-west of England the strongest winds were felt between 10h. p.m. and midnight, and the gusts reached a velocity of 66 miles per hour; in the south-west of England the velocity was at least 75 miles an hour. At the mouth of the Thames it is estimated that the gusts were at the rate of about 60 miles an hour. Notwithstanding the great damage caused by wind and sea combined, it does not appear that the wind-velocity was so great as in the storm of March last, when a rate of 100 miles an hour was recorded in the south-west of England, and 83 miles an hour in the north-west. By Monday morning the central part of the storm had advanced to the coast of Norway.

IN the Journal of the Meteorological Society of Japan for September will be found a very useful summary (in English) of the rainfall of China and Corea, by Mr. T. Okada. Some years ago Dr. Supan published a valuable paper on the subject in Petermann's *Mitteilungen*, but since that time the number of stations has increased, and Mr. Okada has summarised in a handy form the results for forty stations, mostly on the coasts of China and Corea, for the years 1892–1901. The materials are obtained from observations published by the Zi-ka-wei and Hong Kong observatories, and other sources. In northern China the average annual rainfall is under 40 inches; it increases to the southward, and decreases from the coast towards the interior of the Empire, and in individual years it is subject to large fluctuations. In Corea the annual fall is about 36 inches on the west coast, and is generally more than 40 inches on the east and south coasts. In northern China the wettest months are July and August, and February is the driest month. In southern China the wettest month is June, and the driest December. Tables are given showing the average monthly falls at all stations. The coast of central China has an average of 120 rainy days, southern China 80 days, and northern China 60 days. Heavy rainfall in twenty-four hours is rather rare, but falls of 4 inches frequently occur between April and August. In Corea falls of more than 4 inches in a day rarely occur. There is only one instance of more than 8 inches. A table is given showing the greatest daily falls in each month for all stations.

A REPORT has been received on the use of platinum resistance thermometers in determining the temperature of the air at Helwan, the central Egyptian observatory. The object of the paper is to justify the use of a special form of platinum thermometer invented by the writer of the report (Mr. E. B. H. Wade), in conjunction with Prof. Callendar's electric recorder. Instead of coiling the platinum wires on mica supports, and enclosing them in a solid tube for protection, as in the ordinary recorder, Mr. Wade arranged them in an open manner on a light ebonite frame, somewhat in the form of a gridiron, without any kind of casing, the wire being completely exposed to the air. It is claimed, among other things, that the influences of radiation and the Joule effect are much

smaller in this type than in the ordinary one, that it acts more rapidly in its indications, and that the combined recorder and open thermometer may be standardised in such a way as to require no control readings. The author gives a number of tables which seem to show that the advantages claimed are supported by the results obtained. Specimens of thermograms obtained by the employment of the usual and of the modified type show that the fluctuations are more minute in the latter case. It is also stated that Prof. Callendar has expressed approval of the reasons which have led to the adoption of the modified type of thermometer.

THE *Rendiconti* of the Royal Lombardy Institution, xxxviii., 16, contains a short abstract of the report for 1904 of the meteorological observatory on Monte Rosa, by Dr. Camillo Alessandri. The "Capanna Regina Margherita," of which the first wing was opened in 1893, has from that time onwards been visited by many observers, chiefly in connection with physiological researches, and Prof. Mosso's work in this direction is well known; but it was not until May, 1904, that the Italian Meteorological Office placed Dr. Alessandri in official charge of a meteorological station there. During the short time available up to the date of the report, observations were made of temperature, atmospheric electricity, refraction, and time. The climatic conditions occasion great difficulties with the use of instruments, and the author proves the necessity of devising new forms of instruments specially adapted to these conditions. As a beginning, a new metallic thermometer and a registering electrometer have been described by Dr. Alessandri himself.

THE twentieth Bulletin issued by the Geological Survey of Western Australia (Perth) covers 127 pages, and forms a further report by Mr. A. Gibb Maitland on the geological features and mineral resources of the Pilbara goldfield. It includes full details regarding the Nullagine, Warrawoona, and Marble Bar fields, and is accompanied by coloured geological and mining maps. Special interest attaches to the Nullagine district on account of the occurrence of gold in sedimentary rocks bearing a close resemblance to the auriferous conglomerates of the Witwatersrand. The auriferous deposits of Warrawoona and of Marble Hill are quartz reefs.

AN interesting preliminary report has been issued by the mines branch of the Canadian Department of the Interior on the raw materials, manufacture, and uses of hydraulic cements in Manitoba. It has been drawn up by Mr. J. Walter Wells, and involved an examination of the limestones, marls, clays, shales, and coal deposits of the province. Particulars are added of the cement mills in North Dakota, in Minnesota, and in South Dakota; and much information is given regarding the manufacture of cement from the raw materials available that cannot fail to be of practical value in furthering the cement industry of Manitoba. In that province timber is becoming scarce, and suitable building stone and bricks are expensive. Cement is therefore coming into increasing use in house and farm construction, in railway work, in municipal work, and in factories and mills; and within the last eight years the uses of concrete have been greatly extended by the introduction of iron and steel reinforcements, consisting of skeleton structures so arranged in the concrete masses that rods, bars, wires, and bands help in resisting stresses in tension. A very important application of reinforced cement concrete in Manitoba is the construction of grain elevators. The various applications of cement in the province are well shown in photographic illustrations accompanying the report.

AT the last meeting of the Institution of Mechanical Engineers a paper was read by Dr. H. C. H. Carpenter, Mr. R. A. Hadfield, and Mr. Percy Longmuir on the properties of a series of iron-nickel-manganese-carbon alloys. It constituted the seventh report to the Alloys Research Committee, and formed an interesting continuation of the previous reports presented by the late Sir William Roberts-Austen. The research was carried out at the National Physical Laboratory, the alloys having been prepared by Mr. Hadfield at his works at Sheffield. The alloys contained on an average 0·44 per cent. of carbon and 0·88 per cent. of manganese, and the following percentages of nickel:—A, nil; B, 1·20; C, 2·15; D, 4·25; E, 4·95; F, 6·42; G, 7·95; H, 12·22; J, 15·98; and K, 19·91. The report embodies the results of an exhaustive examination of the mechanical, physical, chemical, and metallographical properties of these alloys. It has previously been shown that an increase in the content of nickel raises the maximum stress and lowers the extension. The present research shows that, so far as industrial products are concerned, a danger limit for nickel content is found at $4\frac{1}{2}$ per cent. when carbon and manganese are present to the extent of 0·44 per cent. and 0·88 per cent. respectively. The brittle zone extends from about 5 per cent. to 16 per cent. of nickel. The report, which covers 102 pages, contains a mass of observations of the greatest scientific interest, and the Institution of Mechanical Engineers is to be congratulated on having promoted a costly research of which the immediate practical value to the engineer is very slight.

WE have received from Mr. A. Gibb Maitland a copy of an interesting paper read by him before the Western Australian Natural History Society on the salient geological features of British New Guinea. The territory was annexed to the Crown in 1888, and in 1901 passed into the possession of the Commonwealth of Australia. The geology presents many points of interest. New Guinea rests upon a submarine bank which has been termed the Melanesian Plateau and is separated from another by an abyss 2000 fathoms deep. The coral formations of British New Guinea are very remarkable. All gradations from reefs only a few feet above the water up to 2000 feet in height were noticed. The reef masses are composed of very hard limestones. Coral fragments do not appear to be very common. The volcanic phenomena present all phases, their products being scattered over almost the whole length of the possession. The various sedimentary rocks are well developed in many portions of the territory, and, so far as at present understood, they comprise:—(1) Kevori grits (post-Tertiary); (2) Port Moresby beds (Pliocene); (3) Boioro limestones (undetermined age); (4) Purari River beds (Cretaceous); (5) Strickland River shales (Jurassic); (6) Tauri limestones (Devonian); and (7) metamorphic rocks and crystalline schists. The last named are of considerable economic importance in that they form the original matrix of those deposits that have yielded, from 1888 to 1904, alluvial gold to the value of 255,115*l*. Fragments of coal have been met with in the Purari River beds. It is believed that the formation must attain a thickness of 3000 feet, which would leave room for the intercalation of coal seams. Should a coalfield exist it might exercise a great influence on the future of the possession.

AN interesting paper on the linear force of growing crystals is contained in the *Proceedings of the Washington Academy of Sciences* (vol. vii. p. 283); the authors, Messrs.

G. F. Becker and A. L. Day, direct attention to the fact that in the study of ore deposits occurrences are observable in which crystals have exerted a very considerable force. Pyrites, for example, is formed in slate in such a way as to drive apart the laminæ of the rock without any perceptible deformation of the crystals occurring. A description is given of some experiments performed in order to determine the lifting force exerted by crystals of alum growing in a saturated solution whilst subjected to the pressure of a heavy weight. Under the title "An Interesting Pseudosolid," the same authors contribute an account of some investigations of the behaviour of fresh white of egg beaten into a fine foam with an equal volume of powdered sugar. Cylinders of uniform size were cut out of the mass of foam and subjected to compressive or tensile stress, the changes in the dimensions being carefully observed. A series of photographs of the entire foam cylinder after successive increments of compression was made, and then, by superposing the plates, accurate traces of the path of each component particle were obtained. The authors consider that the results obtained offer a confirmation of Prof. J. J. Thomson's theory of solids.

Mr. Wilhelm Engelmann, of Leipzig, has published a fourth, revised edition of Prof. P. Groth's "Physikalische Krystallographie und Einleitung in die krystallographische Kenntnis der wichtigsten Substanzen." The third edition of Prof. Groth's famous book was the subject of an article in our issue for January 30, 1896 (vol. liii. p. 289). Many students of crystallography will welcome the present edition.

A second edition of Dr. F. Mollwo Perkin's "Qualitative Chemical Analysis, Organic and Inorganic," has been published by Messrs. Longmans, Green and Co. The first edition was reviewed in our issue for August 22, 1901 (vol. lxiv. p. 397); and all that need now be said is that more theory has been introduced, the portions dealing with the analysis of acids and the treatment of the substance to be analysed have been recast, and several additions have been made, those in organic analysis being specially intended for university and pharmaceutical students.

A sixth edition, revised and enlarged, of Prof. R. Wiedersheim's "Vergleichende Anatomie der Wirbeltiere" has been published by Mr. Gustav Fischer, of Jena. An English edition, founded on the third German edition, was reviewed in Nature for September 1, 1898 (vol. lviii. p. 409). It is only necessary to state here that this standard work continues to grow in bulk; for instance, the bibliographical appendix, which in the English edition referred to runs to some ninety pages, occupies in the new edition nearly 140 pages.

Mr. Aksel G. S. Josephson, of the John Crerar Library, Chicago, has sent us a copy of a pamphlet in which he puts forward a proposition for the establishment of a bibliographical institute. Mr. Josephson maintains that as there are laboratories for chemical, physical, and hygienic research, there should also be an institute for conducting bibliographical research, where records of literary productions would be made systematically, and to which persons desiring information of a bibliographical character could turn with their inquiries. Such an institute, he remarks, organised as a bureau of scientific information, would be a boon to all investigators. The institute should be established on an international basis, and its function should be to record, classify, and evaluate printed literature. It should be part of the regular duty of the staff of the institute to index the society publications which are not included in existing indexes to periodical literature. Bibliographies of special subjects should be prepared to fill existing gaps. To establish such an institute on a reasonably permanent basis would, Mr. Josephson estimates, require an endowment of at least 200,000*l*.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in December:—

Dec.	2.	5h. Saturn in conjunction with Moon (Saturn 1° 21′ S.).
,,	3.	10h. 49m. Minimum of Algol (β Persei).
,,	6.	7h. 38m. Minimum of Algol (β Persei).
,,	8.	5h. 35m. to 6h. 43m. Moon occults μ Ceti (mag. 4·4).
,,	9.	4h. 49m. to 5h. 43m. Moon occults *f* Tauri (mag. 4·3).
,,	9.	5h. 48m. to 7h. 21m. Transit of Jupiter's Sat. III. (Ganymede).
,,	10.	4h. 58m. to 5h. 56m. Moon occults γ Tauri (mag. 3·9).
,,	10.	14h. 52m. to 15h. 53m. Moon occults α Tauri (mag. 1·1).
,,	10.	Saturn. Major axis outer ring $=38''\cdot34$. Minor axis $=7''\cdot31$.
,,	10–12.	Epoch of December meteors (Geminids, Radiant $108°+33°$).
,,	15.	Venus. Illuminated portion of disc $=0\cdot970$. Of Mars $=0\cdot900$.
,,	16.	9h. 5m. to 10h. 41m. Transit of Jupiter's Sat. III. (Ganymede).
,,	19.	19h. 53m. to 21h. 2m. Moon occults γ Virginis (mag. 3·0).
,,	22.	0h. Sun enters Virgo. Winter commences.
,,	23.	12h. 26m. to 14h. 6m. Transit of Jupiter's Sat. III. (Ganymede).
,,	25.	16h. Mars and Saturn in conjunction (Mars 0° 30′ N).
,,	26.	7h. Uranus in conjunction with the Sun.
,,	26.	9h. 21m. Minimum of Algol (β Persei).
,,	29.	6h. 10m. Minimum of Algol (β Persei).
,,	30.	20h. Neptune in opposition to the Sun.

Comet 1905*b*. The observation of comet 1905*b* at Bamberg on November 18 was made by Prof. Hartwig, who, in addition to determining the position given in these columns last week, recorded that the magnitude of the comet was 7·5, that the object was round with a diameter of 10′, and that the central nucleus had a magnitude of 11·0.

An observation made by Prof. Aitken at the Lick Observatory on November 18 gave the comet's position, at 8h. 17m. 31s. (Mount Hamilton M.T.), as

$$\text{R.A. (app.)}=0\text{h. }33\text{m. }54\cdot4\text{s., dec.}=+77°\ 17'\ 26''.$$

The appearance and the rapid apparent movement of this object seem to point to its comparative proximity to the earth (*Astronomische Nachrichten*, No. 4055).

The following elements and ephemeris, which have been computed by Herr M. Ebell from the observations of November 18, 19, and 20, are given in Circular No. 80 of the Kiel Centralstelle:—

Elements.

T = 1905 October 27·4926 (Berlin M.T.).

$$\left.\begin{aligned}\omega &= 135°\ 38'\cdot7\\ \Omega &= 223\ \ 45\cdot4\\ i &= 138\ \ 54\cdot6\end{aligned}\right\}1905\cdot0$$

$$\log q = 0\cdot02626$$

Ephemeris 12h. (Berlin M.T.)

1905	α (h. m. s.)	δ	log Δ	Brightness
Dec. 2	... 23 30 49	... +1 11·8	... 9·7150	.. 0·20
6	... 23 30 49	... −4 46·6	... 9·8163	... 0·12
10	... 23 31 28	... −8 36·1	... 9·9002	.. 0·08

Brightness at time of discovery = 1·0.

An observation made at Bamberg on November 21 gave corrections of −32s. in R.A. and +4′·1 in declination to the above ephemeris.

AN UNTRIED METHOD OF DETERMINING THE REFRACTION CONSTANT.—In No. 8, vol. xiii., of *Popular Astronomy*, Mr. Geo. A. Hill, of Washington, describes a new and, as he believes, an untried method for determining the constant of refraction.

Briefly, the method consists in observing the times at which two stars, separated by about twelve hours in right ascension, and both of nearly the same declination, transit across a horizontal wire *in the prime vertical*. In each case the refraction decreases the hour angle, and the arithmetical sum of the hour angles of the two stars will differ from the difference between their right ascensions by twice the refraction, expressed in time, at the zenith distance at which they were observed.

To make this observation Mr. Hill proposes the employment of an instrument similar in form and in the rigidity of its parts to the modern zenith telescope. The telescope is to be established in the prime vertical, and mounted so that it is capable of rotation about a rigid vertical axis. Two stops fixed to the base of the instrument would ensure that when the telescope was rotated in azimuth about the vertical axis its line of collimation would still be in the prime vertical. Obviously the ideal position for the making of the observations would be at or near to the earth's equator. Many other details of the proposed plan of observations are given at length in Mr. Hill's paper.

SPECTRA OF BRIGHT SOUTHERN STARS.—An appendix to vol xxviii. of the Annals—the volume in which appeared the "Catalogue of the Spectra of Bright Southern Stars"—has just been published by the Harvard College Observatory. It contains two tables, in the first of which there are given the particulars of sixty-nine stars which were accidentally omitted from Table I. in the original volume, and in the second the corrected classification of the spectra of thirty stars which were previously wrongly described.

A CATALOGUE OF 4280 STARS.—No. 15 of the *Publications of the Cincinnati Observatory* is devoted to a catalogue of the positions and precessional constants of 4280 of the stars given in Piazzi's catalogue.

All the stars given by Piazzi that were north of the equator in 1800, except those included in the Berlin "Jahrbuch" and eighteen of the Pleiades group, are included in the catalogue, and the Piazzi number, the position for 1900, the precession, the proper name, and the magnitude are given for each. An appendix contains the proper motions of 35 stars which were placed on the observing list, mostly taken from the Cambridge A.G. Catalogue.

HIGHER EDUCATION AT THE CAPE.

HIGHER education in Cape Colony is at the present time in a very interesting and perhaps critical condition. It is indeed characteristic of the tardiness of progress in that colony (the eternal motto is "Wacht een beetje") that the crisis should not have arrived until nearly eighty years after the foundation of the first institution designed to promote advanced studies—the South African College in Cape Town. The causes of this retardation are to be found partly in dissipation of effort, partly in the mischievous influence of an iron system of external examinations. The South African College was started on a small scale in 1829 through the liberality of a number of citizens of Cape Town, who became "shareholders" in the venture; but though after a few years it was recognised as a public institution and received support from the public treasury, it did not at first develop with much rapidity; and in 1849 Bishop Gray, after an unsuccessful attempt to buy out the majority of the "shareholders," founded the Diocesan College as a rival institution in the suburbs, thus inaugurating the unhappy policy of multiplying colleges from which the colony still suffers. Four years later Sir George Grey's administration instituted a public board of examiners with power to grant certificates in various subjects, another fateful step, for from that board there sprang in 1873 the University of the Cape of Good Hope, the only body in South Africa which has the right to confer degrees. The character of this so-called university deserves notice. It was modelled on the old University of London, the example of which it follows only too faithfully. It is managed by a council, half the members of which are appointed by Government, the other half elected by the convocation of graduates. It exercises the two functions of examining and granting degrees, but it does not teach. So abhorrent to it, indeed, is any connection with teaching that it does not allow teachers of candidates to take part in the examinations, a most deleterious prohibition, since in many subjects the only experts belong to the staffs of the colleges. Dissatisfaction with this examining university is the chief cause of the present crisis. Meantime the multiplication of colleges and the wasteful reiteration of similar work in a number of centres has gone on apace. Some of the smaller colleges have, it is true, died out; but there still remain, in addition to the two already mentioned, the Victoria College at Stellenbosch, which was incorporated in 1881, the Huguenot College for Women at Wellington (1898), and the Rhodes University College, which in 1904 took the place of St. Andrew's College at Grahamstown. The western province, therefore, has four colleges, all within forty miles of Cape Town, and the eastern province has one. They are bound hand and foot by the syllabuses and regulations of the university, for the examinations of which they prepare. Alike in strength and in character, however, they vary greatly. The South African College has in recent years developed with wonderful rapidity. It now supports seventeen chairs and has about 260 students, whom it draws in approximately equal numbers from the British and from the Dutch, and in thus bringing the two races together exercises a most beneficent influence, which it rightly regards as one of its chief claims to support. Its arts buildings are old and need reconstruction, but blocks of science buildings have lately been erected which would do credit to any unversity in the Empire, and the intention is to house the arts also on a similar scale. The only other college approaching it in strength is that of Stellenbosch, which has also developed recently, though it remains somewhat smaller and is less well equipped for the teaching of science. That the two strongest colleges should be in such close proximity is a particularly unfortunate result of the short-sighted policy (or lack of policy) which has been characteristic of the educational administration of the colony in the past. On purely educational grounds this duplication cannot be justified. But it is to be feared that racial rather than properly educational motives have led to the development of a second large college so near to Cape Town, and this may be said without any reflection upon the instruction given at it. For the Victoria College is almost completely under the influence of the neighbouring theological seminary of the Dutch Reformed Church; its students are almost entirely Dutch; it is in sentiment and in popular estimation the Dutch College. Even were the instruction provided the best in the world, it would be still altogether deplorable that this tendency to racial separatism in education should have gained recognition and support. Of the remaining colleges, that at Grahamstown has a fairly large staff, but as yet few students and no buildings, and in view of the backward state of education in the east its position seems a little precarious, but if it can encourage the schools in that part to improve it should prosper. The Diocesan College and the Huguenot College are both small, and probably they will in the end have to unite with their more powerful neighbours.

The education provided by the colleges is not so good as it might be under more favourable conditions. One at least of them, the South African College, is in every way competent to give as advanced instruction as most colonial universities, and equally with them to promote research; but it is hampered at once by the schools below it and by the university above it. In mathematics, indeed, the general standard of the schools is remarkably high; a few schools maintain a fair standard in science as well, but in literary subjects they are all miserably weak. This is partly due to the absence of any proper system of secondary or of intermediate education. The Education Department is frequently accused of an undue affection for red tape, with which it is said to strangle the more advanced and ambitious schools in the interests of weaker country schools, that have to be kept up to the mark by strict regulations. However that may be, there is no advanced secondary education in the colony. The schools do not

carry their classes beyond the matriculation examination of the university, which thus serves as a general leaving examination, and when their pupils have passed it there is nothing for them to do, if they wish to prosecute their studies further, but to go on to college, however young and crude they may be. So long as the present university system endures it is difficult to foresee any remedy for this. The university does not demand of its candidates for the higher examinations that they should have been trained at a college, and were the schools to develop advanced classes they would merely compete with the colleges in teaching for the intermediate degree examination, the standard of which would be still further lowered. What is wanted is a system of secondary schools entirely independent of any university, the pupils of which would not be sent on to college until they had reached a decent maturity. As things are, the whole educational system of the colony is absolutely subject to the tyranny of external examinations, and for this the university is chiefly responsible.

So unsatisfactory a state of affairs cannot endure much longer. The only radical cure for it is one which Mr. Rhodes attempted to bring about years ago, the institution of a single teaching university in Cape Town. (The eastern province is not yet sufficiently developed to support a separate university, but in view of its great distance from Cape Town the college at Grahamstown might perhaps remain as an affiliated institution until it is strong enough to stand alone.) Such a teaching university Mr. Rhodes would have endowed, and even though, through local jealousies, the chance of his munificence has been lost, his plan remains the wisest and even the most economical. The Government is remarkably liberal in the cause of higher education. It pays, usually up to a limit of 200*l.* a year, half the salary of all professorships or lectureships the institution of which it approves; it pays half the expenses of general maintenance, and issues loans in aid of building schemes on very favourable terms. In the case of colleges which confine themselves to work above the standard of matriculation and have not less than seventy-five matriculated students—*i.e.* at present in the case of the South African and Victoria colleges—the grants in aid of salaries may be increased up to a limit of 350*l.* The public expenditure on behalf of higher education is thus very considerable, but it is dissipated among several centres, and the benefits accruing from it are necessarily less than they would be were it directed to the support of a single teaching university.

Unfortunately, this ideal is even more unlikely of achievement now than it was in Mr. Rhodes's lifetime. Public opinion remains inert, but the colleges have grown, and it would be almost impossible, and probably undesirable, to force them into reluctant amalgamation. Yet something must be done. The country colleges would prefer probably the conversion of the present university into a federal system of constituent colleges, a policy which has, of course, been tried elsewhere, but without much success. In Cape Town, on the other hand, the feeling is growing that, even though other centres may stand aloof, the city itself should do its best to realise Mr. Rhodes's purpose by founding a teaching university. In the South African College it has the means of doing so, and when that institution has completed its present scheme of development its just claim to independence could not be refused. Nothing could be more beneficial to the colony than such a university in Cape Town with well staffed and well equipped professional schools attached to it. Not only would it raise the general standard of education, as no merely examining body can, but it would draw together and train together the best intellects among the youth of the country, and would thus prove an invaluable factor in the work of uniting the races. No doubt it is a costly scheme, and since the Government cannot concentrate its support of higher education, but will have to continue to assist some at any rate of the local colleges, a great part of the burden must fall on private benefactors. But at the Cape itself to arouse enthusiasm for a great ideal should not be difficult, and it may even be hoped that among the men of millions "who live at home at ease," and who are at last beginning to appreciate the dessert of universities, some may be found willing to assist a scheme which is not the less deserving because it is South African.

THE BATOKA GORGE OF THE ZAMBESI.[1]

WHEN I undertook to examine the geological structure of the country around the Victoria Falls on behalf of the council of the British Association, it appeared to me that there were two essential matters on which our information was very inadequate. The first was with respect to the origin of the falls themselves and the singular gorge associated with them, and the second as to the course of the great river for 70 or 80 miles below the falls. The opinion of David Livingstone, stated fifty years ago, that the gorge must have been formed by the sudden opening of a zigzag crack in the earth's crust, had been adopted without question by all subsequent travellers, although hardly anything was known of the cañon beyond the immediate vicinity of the falls.

Before I left England last June, however, a timely store of new information was forthcoming that materially lightened my task. In an able article on "The Physical History of the Victoria Falls" (*Geograph. Journ.*, January), Mr. A. J. C. Molyneux, of Bulawayo, produced strong evidence to prove that the majestic waterfall and its concomitants have been slowly developed by the erosive power of the Zambesi itself. With regard to the course of the river below the falls, unpublished information was most courteously placed at my disposal by the authorities of the British South Africa Co., which showed that a distinguished officer of the company, Mr. F. W. Sykes, the District Commissioner at Livingstone, had succeeded three years ago in penetrating the hitherto unknown country bordering its northern bank for some 40 miles to the eastward of the falls. The report on this journey prepared by Mr. Sykes, and the beautiful photographs by which it was illustrated, were sufficient in themselves to explain the ruling features in the physiography of the district, and incidentally afforded further testimony in favour of Mr. Molyneux's conclusions.

During my own examination of the district in July and August last, I had the inestimable advantage of the personal guidance of Mr. Sykes in my traverse of the country on the northern side of the river from Victoria Falls to Wankie's Drift. In this traverse we were accompanied by Colonel Frank Rhodes,[2] and for part of the distance by Lieut. Burgin, in command of a detachment of native police. The journey entailed a devious and somewhat arduous march of about 120 miles across an almost trackless country, consisting mainly of rugged stony ground covered with low trees. Wankie's Drift appears to lie considerably to the eastward of the position assigned to it on existing maps, its distance in an east-south-easterly direction from Victoria Falls being probably not less than 75 miles as the crow flies.

Our route was roughly parallel to the course of the Zambesi, at first south-eastward for about 20 miles (in a direct line), then toward east-north-east for a further 35 miles, until we crossed the Ungwesi or Kalomo River, and finally east-south-eastward for nearly 40 miles, to the river-crossing at Wankie's. The deep impassable chasms into which all the tributary streams are precipitated as they approach the Zambesi, and the extremely rugged character of the much-dissected ground between them, forbade any passage along the brink of the main gorge except for short distances, and our general line of march was therefore taken beyond the heads of the side-chasms, often many miles from the Zambesi itself. At four places, however, before reaching the Ungwesi, we struck southward to the main river; and at three of these we managed by rough scrambling to descend into the bottom of the gorge. Finding in these places that the ancient lavas of the surrounding plateau—the "Batoka Basalts" of Molyneux—were still, as at the Falls, the only rocks exposed in the gorge, we decided, as time was pressing, to continue along

[1] Abstract of "Report on the Batoka Gorge of the Zambesi and the Country between Victoria Falls and the Confluence of the Deka River," brought before the Geological Section of the British Association at Johannesburg on August 29, by G. W. Lamplugh, F.R.S.

[2] The news, which reached me during the homeward voyage, of the untimely death of Colonel Rhodes at Cape Town on September 21 has overshadowed the otherwise delightful memory of this journey. To have known Colonel Rhodes, the most cheery of travelling companions, at all was inevitably to hold him in affectionate regard. His deep and cultured sympathy in all that pertained to the magnificent Falls, and his efforts to maintain their loveliness unimpaired, deserve the grateful remembrance of all interested in Rhodesia.

the main route until the termination of the basalts was reached. These rocks proved unexpectedly to be continuous to Wankie's, although the "Batoka Gorge" (as it is proposed to name this cañon of the Zambesi) itself ceases 6 or 8 miles above Wankie's, giving place to an open valley with a broad shallow river sprinkled with islets.

On ferrying in a native "dug-out" across the Zambesi at Wankie's we were met by Mr. H. F. Greer, of the British South Africa Co., who holds charge in the district south of the river. Here Mr. Sykes and Colonel Rhodes struck southward to reach the railway at Wankie Coal Mine, 35 miles distant, while Mr. Greer and myself took a westerly course parallel to the Zambesi for about 60 miles, still traversing a basalt-country. We turned aside twice in this westward journey in order to examine the Zambesi valley at places eastward of those reached from the north bank. One of these was at the confluence of the Matetsi with the Zambesi, which is a little below the termination of the narrow gorge; and the other place was about 15 miles farther west, where the structure of the cañon is not materially different from that which it presents in the place where it had been last entered from the northern side of the river.

Mr. Greer having very kindly undertaken to escort me to the headwaters of the Deka River, where previous information had led me to expect that the base of the Batoka Basalts would be found, we then took a south-westerly course to Matetsi Camp. Crossing the railway there, we continued our journey westward, southward, and south-eastward across the upper part of the basin of the Matetsi River, and after some days of hard trekking struck the higher reaches of the Deka, only to find that the interminable plateau-basalts over which the whole of our route had hitherto lain were still the underlying rocks, and that the surrounding country gave no indication of structural change. It had been our intention to return from Deka to the Falls by the old traders' route past Pandamatenka and Gasuma; but as the Bushmen reported that, owing to the exceptionally dry season, no water would be found in Gasuma Vley, this plan became impracticable, and we decided to follow a north-eastward route, parallel to the Deka River for about 60 miles, to the Wankie Coal Mine. Geologically, this proved to be the most interesting part of my journey, and I therefore spent four days at Wankie in further investigation, profiting greatly from the guidance and kind hospitality of the manager of the mine, Mr. J. M. Kearney.

The basalts are cut off abruptly along the lower portion of the Deka valley by a great fault striking approximately north-east, which brings in the sandstones and shales with which the Wankie coal-seams are associated. Some fragmentary plant-remains were collected from the Wankie Coal-measures, and among these Mr. A. C. Seward has recognised Vertebraria, which indicates that the deposits are of Permo-Carboniferous age, as indeed had been previously surmised. Returning by rail from Wankie Mine to Victoria Falls, I spent a few more days in examining the head of the gorge and its surroundings, and was then compelled to leave Rhodesia in order to join the Association at Johannesburg.

The 600 miles of actual trekking that was accomplished embraces a region of some 2000 square miles, of which all except about 80 square miles east of the Deka is underlain by the Batoka Basalts. The full extent of these ancient lava-fields is still unknown, but, judging from information that I obtained, it is likely to be not less than 7000 square miles. Their thickness is also unknown, but in the lower part of the Batoka Gorge, where the original surface of the basalts must have been very considerably lowered by denudation, the Zambesi has sunk for 800 feet further through these rocks without revealing their base. In their prevalent characters they are remarkably uniform, consisting generally of thick bands of close-grained dark-blue rock alternating with red, purple, or ashy-looking amygdaloidal bands which mark off the surfaces of successive lava-flows. These less massive bands frequently show a fragmental structure, and occasionally pass into fine and coarse agglomerates suggestive of volcanic tuffs or ashes; but I think that this structure may represent the brecciation of the solid crust of the lava-flow before its onward movement had ceased, and is not indicative of true ashes. In the whole course of the journey I did not find any trace of an eruptive centre or volcanic orifice, and the rarity of dykes was also remarkable. Neither did I find any interstratified sediments among the basalts in the country traversed, though there appear to be some interstratified red and green beds of shaly aspect in the railway cuttings of the Katuna valley west of the Deka, which I had no opportunity to examine. Like similar "plateau-basalts" in other parts of the world, this immense mass of lava has probably had its origin in "fissure-eruptions," by which a vast tract was flooded under rapidly recurrent flows of high fluidity.

We still lack definite information as to the geological age of the Batoka Basalts; by Mr. F. P. Mennell and Mr. A. J. C. Molyneux they are regarded as most probably Tertiary, while Dr. S. Passarge correlates them with the Loale Amygdaloid, which he considers to be of Secondary age, perhaps Jurassic; but the evidence for either view remains inconclusive.

The surface-deposits of sand, sandy limestone, cavernous quartzite and hematite which locally overlie the basalts in this part of the Zambesi basin, though of considerable interest, must be dismissed for the present with the remark that their mode of occurrence in this region is not favourable to Dr. Passarge's view that they represent a definite order of events. The red sand (equivalent to the "Kalahari Sand" of Passarge, and probably in part to the "Forest Sandstone" of Molyneux) may, indeed, denote a period of conditions different from those now existing; but the limestones and quartzites appear to me to be due to purely local circumstances that still prevail.

Let us now turn to regard briefly the physiography of the region;[1] in which respect that wonderful natural feature, the Victoria Falls, is, of course, the main pivot of interest.

Above the Falls, the Zambesi flows sedately in a broad mature valley with low sides, excavated in the upper portion of the Batoka Basalts. The gentle slopes of this valley are partly buried under ancient desert-sands—the "Kalahari Sand" of Passarge—and all the features point to a long continuance of relatively stable conditions during which the river has done very little erosive work. On the brink of the Falls its bed is still about 3000 feet above sea-level; but at this point, suddenly, with a majestic plunge, the Zambesi begins its impulsive descent from the central plateau, and thereafter tears its way forcefully across the mountainous margin of the continent, through a succession of gorges alternating with relatively placid reaches according to the variable endurance of the rock-masses that lie in its path. It is to this rejuvenation of the river at the present margin of the plateau, and its resultant influence upon certain structures of the basalts, that, as Mr. Molyneux has shown, we owe the magnificent Falls, and not to any catastrophic rending of the earth's crust.

The Batoka Basalts are traversed by a regular and persistent system of close-set joints striking approximately east and west, and are also occasionally fractured in the same direction by still bolder vertical planes, probably representing lines of fault, that are sometimes accompanied by veins of calcite and other minerals. At the surface of the plateau the basalts are much weathered, and this weathering sinks deepest along the joints and fractures, whereby these become the lines of readiest erosion.

The rivers of this country are characterised by the enormous difference that obtains between their volume in the dry and in the wet seasons, a difference which affects the great Zambesi proportionately almost as much as its tributaries. During the shrinkage of the streams, the greater portion of their broad rocky beds is laid bare, and the water is confined within narrow gullies along the joints and lines of readiest erosion, so that for more than half the year it is in these channels only that there is any wearing down of the stream-bed, while in flood-time it is still along these gullies that the water is deepest and most forceful, and that the chief portion of the detritus (astonishingly scanty in these African rivers) is swept. Thus, granting a sufficient gradient, these dry-season channels become deepened and enlarged until they are

[1] This portion of the report was illustrated by lantern slides showing the chief features of the Gorge.

capable of carrying the flood-waters also, and the course of the stream becomes fixed along them. We found striking illustrations of these conditions both in the Batoka Gorge and in the beds of the tributaries in many places. The sudden and acute bends that are so peculiarly characteristic of the Zambesi below the Falls are in this way readily explicable.

A broad ancient river-flat, with low sloping banks on both sides, excavated across the edges of the gently dipping lava-flows, is distinctly traceable for many miles below the Falls, until obscured by the breaking up of the plateau by the gradually lengthening development of the lateral chasms of the rejuvenated tributaries. This flat is comparable in breadth and general aspect to the valley of the Zambesi above the Falls; and the presence of a few rounded pebbles upon it above the brink of the gorge gives further evidence for the former flow of the river over its surface. It is continued southward as a shallow depression in the surface of the plateau for five or six miles from the Falls, and then curves eastward.

It may be mentioned here, as a matter deserving the attention of archæologists, that rudely chipped implements of chalcedony, agate, and jasper are very abundant in many places on this ancient river-platform, and also upon the low rocky hummocks bordering the Zambesi above the Falls. A few of these implements show signs of wear as if by river-action, and may therefore possibly be of considerable antiquity. We found them, here and there, in profusion during the first 20 miles of our eastward journey, but very rarely during the later stages of the trek. A collection of these implements was exhibited at a meeting of the Anthropological Section.

The erratic zigzags of the Batoka Gorge swing to and fro within this broad depression, but without escaping from it. Even within the gorge, the river, still possessing a high gradient, tends to confine itself within narrower limits as it scoops out the less resistant portions of its bed, leaving many abandoned channels, rock-terraces, and spur-like ridges to break the severity of its cañon walls.

Nowhere can these features be better studied than in the left bank of the Gorge, about 7 miles below the Falls, around the confluence of the Songwe, a little tributary which has itself carved out a narrow chasm about three-quarters of a mile long and more than 400 feet deep into the margin of the plateau. As well for its savage magnificence as for its scientific interest, this spot deserves to be visited; and one may be allowed to express the hope that the responsible authorities will undertake the comparatively light work of clearing a track from the Falls, to render it accessible to the tourist.

To one whose first impressions of the Zambesi had been gained from the mile-wide river above the Falls, it was astonishing to find the whole river, at its present low stage, confined at this place within a channel not more than 35 yards in width—bordered, it is true, by a rocky scar, about 150 yards wide, honeycombed with deep "pot-holes," which was evidently submerged during the floods. After seeing it one could understand how the idea has arisen—and still lingers—that part of the Zambesi is swallowed up at the Falls into an underground channel.

But even this is not the narrowest limit within which the great Zambesi can confine itself at low water; for on reaching the bottom of the gorge at the Tshimamba Cataracts, some 20 miles east of the Songwe, we found the whole river raging tumultuously through a water-channel which, at one place, was less than 25 yards in breadth (Fig. 1). This place is apparently the only part of the interior of the Batoka Gorge that was ever penetrated by the white man until Mr. F. W. Sykes's expedition of 1902. His predecessor here was David Livingstone, who in his second book of travels tells how he turned aside on his eastward journey at the rumour of another great waterfall, and was disappointed to find, not a second Victoria Falls, but only a bold cataract, in which the river drops about 20 feet. Nevertheless, the Tshimamba also, were it rendered more accessible, would be well worth visiting, if but to see the mighty river shrunk to this little measure; and one may expect, sooner or later, to find it included within the "grand tour of the Zambesi."

Although the surface of the basalt plateau falls steadily eastward, the Zambesi within its gorge sinks somewhat more rapidly in the same direction, so that while immediately below the Victoria Falls the river is barely 400 feet below the lip of the gorge, this is increased to about 500 feet at the Songwe, to about 600 feet at the Tshimamba, and to 800 feet at the place some 35 miles farther east which we reached from the south bank. Aneroid observations showed a difference of more than 900 feet between the level of the river at the foot of the Falls and Wankie's Drift, which represents the descent of the water in passing through the Batoka Gorge; and until this steep gradient is very much reduced the Zambesi must continue to deepen its channel along the easiest lines before there is time for it to straighten out the angularities of its course.

The results attained by this selective erosion are strikingly exemplified in the immediate surroundings of the Victoria Falls. The wonderful Chasm, in places only 80 yards wide, into which the broad river is here precipi-

From a photograph by Mr. F. W. Sykes.

FIG. 1.—The Gorge immediately below the Tshimamba Cataract. The depth of the cañon here is about 600 feet. The Zambesi, in the foreground, is confined in a channel from 20 to 25 yards wide. Note how the strong jointing of the basalt governs the course of the river and tends to produce zigzags in the low-water channel.

tated, owes its chief features to the presence of an east and west vein, probably a fault-plane, that cuts vertically through the basalts. This vein, which I found to be well exposed in the steep Recess or gully at the eastern end of the Chasm, is partly filled with calcite and other soft vein-stuff, and the rock adjacent to it is shattered and readily decomposed. When the falls, in receding northward, struck upon this vein, they readily hollowed out a transverse trench across the whole breadth of the river, from which the waters escape southward through a single narrow channel. But, having passed this easy place, it is becoming increasingly difficult for the shallow river to support a fall of its full width, and consequently the wearing back of the lip is at present progressing most rapidly in a comparatively narrow space at its western margin. Here the "Leaping Water" pours a strong flood perennially into the corner of the Chasm, and may eventually concentrate the whole of the river into its trough, unless, as Mr. Molyneux has suggested, the deep oblique cleft that is being rent across Cataract Island should gain precedence

in the backward race. The narrowness of the cañon below the falls, as compared with the breadth of the river above them, shows that only by such concentration has the Zambesi been enabled to tear out its gorge so far back into the plateau.

Mr. Molyneux has rightly laid stress on the behaviour of the tributaries as proof of the erosive origin of the Batoka Gorge. Above the Falls the tributaries have so nearly reached their base-level relatively to the Zambesi that they hold deep back-waters where they join the main river, of which the Maramba, 2 miles from the Falls, presents a good example. But below the Falls they have at first been left in shallow open "hanging valleys," high above the main artery; and thus rejuvenated by a sheer drop of 350 feet or 400 feet, each little stream has begun to work vigorously backward into the

From a photograph by Mr. F. W. Sykes.

FIG 2.—Kalonga's Cleft on the Karamba River. The walls are about 300 feet high.

plateau along its own line of drainage. Each waterfall tends to recede farther and farther within its own precipitous rift as we followed the Zambesi downward, so that while at first it was possible to round the heads of these by a detour of a few hundred yards, we found that farther east not only do they extend far back into the plateau, but many minor clefts branch out from them, rendering the country a maze of dangerous chasms. In these waterfalls and rifts the salient features of the main gorge are often reproduced in miniature. The most remarkable example that we visited occurs on the Karamba, a stream which joins the Zambesi about 35 miles east of the Falls. Some 5 miles above its junction with the Zambesi this stream drops by a waterfall from its open shallow valley into a gloomy recess, from which it escapes by swerving at a right angle between nearly vertical rock-walls, 300 feet in height, through a cleft only 15 feet to 20 feet in breadth (Fig. 2).

If further proof for the erosive origin of the Batoka Gorge be needed, I would direct attention to the gradual falling off in the angle of slope of its sides as we descend the river. At the Falls, where the gorge is freshly cut, its walls are practically vertical; but a few hundred yards below they are already beginning to show the effect of weathering by a slight recession of their crest-line and by indications of terracing along the planes of stratification. At the Songwe confluence, 7 miles farther down, this recession and terracing have become so pronounced that the average angle of slope from base to crest is reduced to 60° or less; at the Tshimamba, about 30 miles below the Falls, it is no more than 35°; and at the mouth of the Karamba, 12 miles farther east, the sides of the gorge have been weathered down into bushy slopes, broken here and there by inconspicuous bars of crag, with an average inclination of about 30°, which is also the character of the cañon at the place where it was visited still farther eastward.

If time had permitted, I should have liked to discuss the curious difference between the broad basin of the Matetsi and the narrow trough of the Zambesi within the basaltic plateau, which presents an important problem in the physiography of the region, especially when we remember that the Batoka Gorge terminates at a short distance above the confluence of the Matetsi; but this would open up too wide a subject for the present occasion.

In the face of all the evidence we must conclude—not without a tinge of regret—that the Batoka Gorge can no longer be allowed to stand apart, a unique curiosity, among the valleys of the earth—that no exceptional forces have been brought into action to produce its wonders and its loveliness—but that the everyday effects of river and rain, with time—that indispensable factor to the geologist—a very long time—are ample to explain all its marvels, as they have already explained the marvels of many another noble cañon of the world.

I must not let pass this opportunity of expressing my gratitude for the kindness shown to me by the officers of the British South Africa Company in Rhodesia and also in London, by the engineers of the Wankie Coal Mine and of the Rhodesia railways, and by many other friends in Rhodesia. To Mr. F. W. Sykes I am peculiarly indebted for removing difficulties that, except for his self-sacrificing cooperation, might have proved insuperable. G. W. L.

INDIAN DEEP-SEA HOLOTHURIANS.[1]

THE most recent addition to the list of publications issued by the Indian Museum, Calcutta, deals with a collection of deep-sea Holothurians made by the survey ship *Investigator*, which has rendered valuable service in the interests of deep-sea research. The extreme utility of this work, which will help to elucidate many of the problems connected with deep-sea life, is enhanced by the fact that the investigations have been carried on over comparatively unknown ground, so far as the great depths are concerned.

The area examined by the *Investigator* is a comparatively wide one, and ranges over the northern part of the Indian Ocean from the Persian Gulf to the east side of the Bay of Bengal.

Most of the deep-sea expeditions appear to have confined their labours to the Atlantic and Pacific Oceans, and even the *Challenger* did not touch the northern part of the Indian Ocean. The *Siboga* Expedition reached the extreme south-eastern portion of the *Investigator* area, and a comparison of the *Siboga* Holothurians with those in the paper under notice provides an interesting study, and, incidentally, confirms the opinion that a knowledge of the distribution of deep-sea forms derived from an examination of isolated areas is apt to be misleading.

Of the seventy-five species and varieties described in the report, no less than sixty are new to science. The Synallactidæ appear to be the predominant forms amongst the deep-sea Holothurians of the Indo-Pacific region, both

[1] "An Account of the Deep-sea Holothurioidea collected by the Royal Indian Marine Survey Ship *Investigator*." By R. Kœhler and C. Vaney. Pp. 123; 15 plates. (Indian Museum, Calcutta, 1905.)

with regard to species and individuals. In the *Investigator* collection twenty-nine species are placed in this family, and the Molpadiidæ and Synaptidæ are well represented. The authors have found it necessary to form ten new genera, and a seventh family—the Gephyrothuridæ—has been added to the Aspidochirotæ.

There was a large number of specimens of the genus Pelopatides and its allies in the collection, and the authors were given an opportunity of revising the genus. Five new genera were established to receive forms closely related to Pelopatides. Dendrothuria is peculiar in having dendrochirote tentacles and an enormously developed pharynx. Pseudothuria has no single distinctive characteristic, but all its characters taken together separate it from the neighbouring genera. The genus Allopatides has been formed from a single specimen, and its main difference from Pelopatides appears to be the richly dendritic form of the spicules. It may be doubted whether this difference is of generic value, especially as some species of Pelopatides also possess branched spicules not differing greatly from those in the new genus; the difference appears to be merely one of degree. The genera Perizona and Bathyzona have been formed mainly with regard to the position of the pedicels. Five other new genera are also described.

The new family—Gephyrothuridæ—is founded on two specimens which differ from all other Aspidochirotes in the possession of ambulacral appendages on the bivium only. In external appearance this form somewhat resembles the Molpadiidæ.

The collection includes some forms described by Walsh in 1891; the authors have deemed it necessary to remove all his species to other genera.

With every increase in our knowledge of the deep-sea fauna, it becomes more possible to formulate with some degree of completeness definite ideas as to the distribution and the mode of evolution of the deep-sea forms; and the work under notice is of importance in this respect, suggesting as it does many interesting points in zoological distribution.

Comparing the *Siboga* list of deep-sea Holothurians with that of the *Investigator*, it is surprising to find that in the two collections from adjacent areas there are only six species common to both. The two gatherings are almost entirely dissimilar with regard to the species present, but an examination of the genera shows a close similarity. It is perhaps noteworthy that those species common to both districts are not confined to the eastern portion of the *Investigator* area, as one might expect, but are scattered equally throughout it.

Of the fifteen species previously described, six are Atlantic and five Pacific forms; there are three species in the collection the distribution of which has hitherto been limited to the Atlantic.

The descriptions are clear and not too scanty, as is often the case, and the plates are good. Altogether the authors have made a most valuable contribution to the subject, and they appear to have done extremely well with material that was evidently not in the best state of preservation.

J. P.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The following decrees were approved by Convocation last Tuesday:—The curators of the University Chest were authorised to pay a sum not exceeding 150*l*. to the professor of botany to enable him to provide for the teaching of forest botany, until the appointment of a Sibthorpian professor under the new statutes of St. John's College.

Mr. Henry Balfour, Fellow of Exeter College, was re-appointed curator of the Pitt-Rivers museum for seven years at a stipend of 200*l*. a year, and the annual grant of 200*l*. to the museum was renewed for seven years.

An examination will be held next February for a Radcliffe Travelling Fellowship of the annual value of 200*l*., and tenable for three years. Candidates must have qualified for the degrees of B.A. and M.B., and have been placed in the first class in a university examination, or have gained a university prize. Names should be sent to the Regius professor of medicine.

The following is a list of the probationers for the Indian Forest Department and the Sudan nominated in 1905, with the colleges to which they are now attached:—C. W. Armstrong, scholar of Jesus College, Oxford; G. C. Clarence, Magdalen College, Oxford; T. Clear, science exhibitioner of Balliol College, Oxford; C. G. E. Dawkins, Balliol College, Oxford; C. C. Gaunt, exhibitioner of St. John's College, Oxford; H. S. Gibson, Trinity College, Oxford; H. M. Glover, mathematical demy of Magdalen College, Oxford; J. Gunn, Edinburgh University, now at St. John's College, Oxford; J. K. Hepburn, Queen's College, Oxford; N. W. Jolly, Adelaide University, now at Balliol College, Oxford (Rhodes scholar); W. A. H. Miller, St. John's College, Oxford; A. J. W. Milroy, Christ Church, Oxford; A. A. F. Minchin, Exeter College, Oxford; R. L. Robinson, Adelaide University, now at Magdalen College, Oxford (Rhodes scholar); E. A. Smythies, Christ's College, Cambridge, and Balliol College, Oxford; and G. C. Wilson, Queen's College, Oxford.

The Government of Mysore has sent two forestry students, M. M. Machaya and B. V. Ramaiengar, both of St. John's College, Oxford, and of Madras University.

Cambridge.—The Forestry Syndicate has now issued its detailed report on the scheme for establishing a diploma of forestry. It is proposed that a committee of the Board of Agricultural Studies be appointed to be called the forestry committee, the duty of which shall be to manage the examinations in forestry and to direct the instruction and training of candidates for the diploma. Details as to the constitution and duties of the committee are printed in this week's *Reporter*.

The general board of studies has appointed Mr. J. G. Leathem, St. John's College, university lecturer in mathematics from Christmas, 1905, until Michaelmas, 1910, and has re-appointed Mr. C. T. R. Wilson, Sidney Sussex College, university lecturer in experimental physics from Christmas, 1905, until Michaelmas, 1910; both these appointments have been confirmed by the special board for physics and chemistry.

Mr. A. C. Seward, of Emmanuel College, has been appointed chairman of the examiners for the natural sciences tripos, 1906.

The late Mr. G. R. Crotch, of St. John's College, some years ago left his collections of insects and his books to the Museum of Zoology, and also after the death of certain relatives his personal estate to the same museum. His brother, Mr. W. D. D. Crotch, who recently died, has left his residuary estate, the value of which is about 8000*l*., to the same museum.

Sir Alexander R. Binnie will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 21.

The Public Schools Science Masters' Association will meet for the annual conference on January 20, 1906, at Westminster School. The president for the year, Sir Oliver Lodge, will speak on the place of science in general education. Papers will be read upon the army examination and on the possibility of introducing a comprehensive syllabus of science teaching within the time limits of a classical curriculum. After the conference there will be an exhibition of scientific apparatus by various makers in the new science buildings of Westminster School.

The North of England Education Conference will be held at Newcastle-upon-Tyne on Friday and Saturday, January 5–6, 1906. Among the subjects to be discussed are the following:—The teaching of elementary mathematics, paper by Prof. R. A. Sampson, F.R.S.; openers of discussion, Dr. Jude and Mr. J. H. Kidson. Regulations for secondary and higher elementary schools, papers by Mr. W. Edwards and Mr. W. J. Abel; openers of discussion, Miss M. Moberly and Mr. P. M. Greenwood. Organisation of evening classes, papers by Principal J. H. Reynolds and Mr. J. Crowther; opener of discussion, Mr. A. M. Ellis. Physical Training, papers by Prof. T. Oliver and Captain H. Worsley-Gough; openers of discussion, Dr. Ethel Williams and Captain F. C. Garrett. All com-

munications with reference to the conference should be addressed to the hon. secretaries, Mr. Alfred Goddard and Mr. F. H. Pruen, Education Offices, Northumberland Road, Newcastle.

SEVERAL changes have taken place, we learn from *Science*, in the staff of the research laboratory of physical chemistry of the Massachusetts Institute of Technology. Prof. W. D. Coolidge has accepted a position in the technical research laboratory of the General Electric Company at Schenectady. To Prof. Coolidge has been due in large measure the development of one of the most important lines of work in progress in the research laboratory of the institute—the investigation of the conductivity of aqueous solutions at high temperatures. Mr. Yogoro Kato, who has also been engaged on the conductivity investigation for two years, has accepted a position in the Technical High School of Tokio, where he will have charge of the work in electrochemistry. Dr. Wilhelm Böttger will return as privatdocent to the University of Leipzig, at which he will conduct one of the laboratory courses in analytical chemistry. In place of these retiring members, Messrs. William C. Bray, Guy W. Eastman, Gilbert N. Lewis, and Edward W. Washburn have been appointed to the research staff.

AT the distribution of prizes to the students of the Mechanics' Institute, Crewe, on November 22, Sir Oliver Lodge delivered an address. He emphasised the importance of the study of pure science and the application of its broad principles, whereby it is possible to make discoveries and to ascertain facts which are not known to the human race. After all the ages of the human race there are innumerable facts which we do not know, and it is now and then given to a man here and there to find them out and pass them on as common property never more to be lost. Sir Oliver Lodge went on to say he does not believe that a thing which really exists can go out of existence. There is an infinitude before us, and it behoves us to realise that and see to it that we fit ourselves for what is to come. We are parts of an industrial organism, parts of a much larger organism, the universe, and in the universe there is one great law of evolution, of growth, and development. The universe is not yet perfect; it is our privilege to help in the process of making it more perfect. Things will not be done on this planet unless we help to do them; we are agents for helping in the process of evolution. Errors or mistakes may cause dislocation or calamity in the great scheme. We have the power of causing dislocation or calamity by errors, or by living strenuous self-sacrificing lives we have the power of cooperating in the great scheme of helping towards the fruition, development, growth, and progress of the universe of which we are an infinitesimal part.

THE inaugural address delivered by Dr. B. C. A. Windle, F.R.S., president of Queen's College, Cork, at the opening of the session, is given the first place in the current number of the *University Review*. Dr. Windle deals in an exhaustive manner with the subject of examinations in Ireland and with the university question. Four deadly errors, he maintains, have long affected England and Ireland. These errors are that acquisition of knowledge and education are synonymous terms; that education—as apart from mere knowledge—can be easily, nay, more, can only be tested by examination; that a degree is in itself an object of value; and that a degree means the same however and wherever it may have been acquired. Dr. Windle regards examinations as an evil, but at present a necessary evil, and proceeds to discuss the objects such examinations should have in view. By means of an examination, Dr. Windle explains, an endeavour is made to ascertain whether the candidate has acquired the necessary knowledge of facts to enable him to proceed to a further stage of learning or—at the end of his course—a sufficient knowledge of his profession to be trusted to go out into the world and practise it independently. An examination is intended, moreover, to ascertain whether a student has acquired the proper methods of gaining and applying knowledge. To secure efficient examinations, the article lays it down, every teacher should take a large share in any examination which his students may have to confront, but the judgment of the teacher should be supported or corrected by the assistance of an external examiner. The conclusion of the article is that there is at present in Ireland, for the great majority of its inhabitants, "a university system which almost necessitates a method of examination which is harmful in its effects on education; a method which leads to subterranean complaints and accusations, which, though they may be, and almost invariably are, false, are none the less injurious to education generally; a method for which, indeed, no excuse can be urged except the excuse that the system arises out of the necessities of a position which never ought to have been created."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, Received September 28.—"Researches on Explosives." Part iii. Supplementary Note. By Sir Andrew **Noble**, Bart., K.C.B., F.R.S.

Since communicating to the Royal Society "Researches on Explosives," part iii., the author has succeeded in obtaining the paper (*Preuss. Akad. Wiss. Berlin Sitz. Ber.*, vol. v. p. 175) by Messrs. Holborn and Austin on the "Specific Heat of Gases at High Temperatures."

The attention of these investigators has been specially directed to carbonic anhydride, and their researches show a considerable (but rapidly decreasing) increment in the specific heat of CO_2 with increase of temperature.

If we suppose the same law of increment which appears to rule up to 800° C. to remain unaltered up to 1300° C., the increments at that temperature would vanish, and, if this be so, the author finds that the specific heat of CO_2, at constant volume, should be taken at 0·2111.

He has therefore re-calculated the specific heats given in his recent paper, and as the specific heats of the exploded gases at constant volume are reduced, the temperatures of explosion given in his paper should also be reduced.

The temperatures the author gives have been obtained by two different methods, firstly, by dividing the heats determined by the calorimeter by the specific heats, and, secondly, by using the equation of dilatibility of gases, and determining the temperature from

$$t = p - p_0/0{\cdot}00367p_0 \qquad (1)$$

where p is the pressure in atmospheres obtained from the explosion, and p_0 the pressure in atmospheres when the volume of gases generated is reduced to 0° C. and 760 mm. bar. pressure.

The differences of the results are very remarkable.

Taking, for example, cordite as an illustration, it will be seen that for the four highest densities given the temperatures derived from the two methods are but slightly different. At the higher density (0·5) the temperatures are 5275° C. and 5263° C., the higher being that derived from equation (1); at density 0·45 the temperatures from the two methods are identical, at density 0·40 the temperatures are 4902° C. and 4970° C., the lower temperature being from equation (1), but after density 0·35 the temperatures derived from equation (1) fall very rapidly.

The same general results are observable in the other two explosives experimented with, and it should be noted that in all three explosives, at the highest densities, the temperatures given by equation (1) are greater than those obtained by the second method.

The figures for the three explosives are given below, the temperatures obtained from $\frac{\text{units of heat}^1}{\text{specific heats}}$ being given in italics.

Cordite.

D=0·50	D=0·45	D=0·40	D=0·35	D=0·30	D=0·25
5275°	5090°	4902°	4710°	4480°	4165°
5263	*5090*	*4970*	*4860*	*4800*	*4770*

D=0·20	D=0·15	D=0·10	D=0·05
3838°	3400°	3140°	2775
4760	*4760*	*4700*	*4800*

M.D.

D=0·45	D=0·40	D=0·35	D=0·30	D=0·25	D=0·20
4713°	4494°	4200°	3920°	3585	3240°
4624	*4411*	*4215*	*4070*	*3945*	*3870*

D=0·15	D=0·10	D=0·05
2800°	2530°	2160°
3840	*3830*	*3860*

[1] Water gaseous.

Nitrocellulose.

D=0·45	D=0·40	D=0·35	D=0·30	D=0·25	D=0·20
4305°	4007°	3630°	3320°	3060°	2835°
3954	*3890*	*3795*	*3670*	*3530*	*3425*

D=0·15	D=0·10	D=0·05
2680°	2520°	2400
3345	*3295*	*3255*

If these figures be examined, it will be noted that in each explosive at the higher densities the temperatures obtained by the two methods are nearly identical, those determined from equation (1) being the higher, but as the density of charge is decreased the difference at the very low densities is remarkable; some of this difference is doubtless attributable to the slow burning under feeble pressures, and to the rapid cooling, by communication of heat to the walls of the explosive vessel during the ignition of the charge, but it is impossible to ascribe the whole difference to this cause, and the author can only suggest that the explanation is to be sought in the probable dissociation of the carbonic anhydride and aqueous vapour at low pressures, this dissociation being prevented wholly or partially by the very high pressures at the higher densities.

Various substances such as carbon, metallic platinum, tantalum, osmium, and titanium have been placed in the charge, and all have been more or less fused and volatilised during the small fraction of a second to which they were exposed to the maximum heat.

A great part of the titanium was recovered in a fused crystalline condition.

Osmium and thin platinum foil were volatilised, and thick sheet platinum was recovered in the form of a button.

Received October 6.—"On the Isolation of the Infecting Organism ('Zoochlorella') of *Convoluta roscoffensis*." By F. **Keeble** and Dr. F. W. **Gamble**. Communicated by Prof. S. J. Hickson, F.R.S.

The authors have obtained experimental proof that the green cells (Zoochlorellæ) which occur in the superficial tissues of the turbellarian *Convoluta roscoffensis* arise in the body as the result of an infection.

Like those of previous investigators (Haberlandt), the authors' attempts to cultivate the green cells isolated from the animal have failed. Indeed, the evidence points to the conclusion that the green cells, once having entered into the body of the animal, lose all power of separate existence. Therefore, in order to solve the problem of the nature of the green cells, the authors were compelled to attack it at the other end, viz. to attempt to discover the organism *before* its entrance into the body.

From their observations on the normal course of appearance of the green cells in the bodies of just-hatched Convoluta, the authors were led to expect that the precursors of the green cells would be discovered on or in the capsules in which the eggs of Convoluta are laid. This proved to be the case. By the isolation of such capsules green colonies of a motile organism were obtained, and the organism was proved to have the power of infecting young, colourless Convolutas, hatched under sterile conditions, and of giving rise in these animals to green cells identical with those which occur in the normal adult.

The infecting organism is in its active state a unicellular four-ciliate alga. It has a single basin-shaped chloroplast occupying the greater part of the cell, an eccentrically placed plate-like eye spot, and a large octagonal pyrenoid at the posterior end of the body. The motile cells frequently come to rest and surround themselves with a thick striated wall. They may also in this resting stage undergo vegetative division, giving rise to a "palmella" condition.

These characters point to the membership of the infecting organism with the Chlamydomonadineæ.

Faraday Society, October 31.—Lord Kelvin, president, in the chair.—Alternate current electrolysis: Prof. E. **Wilson**. Experiments (*Roy. Soc. Proc.*, vol. liv. p. 407) made with platinum plates in dilute sulphuric acid show that of the total energy supplied to the cell in a given time, more is returned to the source when the frequency is high than when it is low, the maximum coulombs being of the order 0·0006 per sq. cm. in each case. If the quantity of electricity be plotted coordinately with the E.M.F. of electrolysis it is found that at the higher frequency, for about the same maximum coulombs, the curve has relatively a smaller area, such reduction being probably brought about by the greater reversibility. An experiment made at an intermediate frequency when the maximum coulombs were 0·0000023 per sq. cm. gave a still higher value for the proportion of the total energy which is returned to the source, demonstrating that the magnitude of the maximum coulombs has an important effect. When a metal is dissolved in an electrolyte by alternate-current electrolysis, the amount dissolved in a given time at a given current density is smaller at high than at low frequency. Besides this chief conclusion there are indications of other important effects. A complete investigation would need to take accounts of the density and temperature of the electrolyte, and possibly of other conditions.—Alternate current electrolysis as shown by oscillograph records: W. R. **Cooper**. Although polarisation is of the nature of capacity in an alternate current circuit, there is a considerable difference. What might be termed the E.M.F. of a condenser rises and falls as rapidly as the applied pressure, but although the E.M.F. of polarisation may rise as rapidly as the applied pressure, it falls more slowly, with the result that under suitable conditions the current curve may depart very considerably from the sine form. Actual oscillograph records are reproduced in support of this view. In considering the subject it has been very generally assumed that the current follows a sine curve. Since the curve obtained depends very much on the conditions of the experiment, it is necessary to define the conditions very carefully before conclusions can be drawn from different experiments. Oscillograph records of electrolytic rectification were also shown.—Note on the crystalline structure of electro-deposited copper: Prof. A. K. **Huntington**. In Mr. Cowper-Coles's process for making copper wire electrolytically a spiral scratch or groove on the mandril causes the copper deposited on it to part so easily that a long ribbon can be obtained. The author's explanation is that the direction of the lines of crystallisation of an electro-deposited metal is the same as in a casting made on surfaces having the same inclination, *i.e.* the crystals form at right angles to the surface on which the deposit or the casting is made.—Some observations respecting the relation of stability to electrochemical efficiency in hypochlorite production: W. P. **Digby**. The author commenced by directing attention to the fact that in all electrolytic methods of producing hypochlorite solutions, only a small portion, rarely more than 18 per cent., of the chlorine usually present in the form of chloride is converted into hypochlorite; and he suggested that the amount of available chlorine produced from a sodium chloride solution depends upon the relation which the amount of unconverted sodium chloride actually present between the electrodes bears to the current density.

Entomological Society, November 1.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—(1) *Panurgus morricei*, Friese, a species of bee new to science taken near Gibraltar, of which it was remarkable that, whereas the species of this genus are wholly black, in this species the ♂ face entirely, and the ♀ partly, was bright yellow, the legs partly yellow, and the abdomen spotted down each side, somewhat as in Anthidium; and (2) the unique type specimen of *Eriades fasciatus*, Friese, a ♂ of the Chelostoma group taken at Jericho in 1899, in which again, while all its congeners are practically unicolorous, the abdomen is brightly banded like a wasp: Rev. F. D. **Morice**. A discussion followed as to the reason of the peculiar coloration in the species under review, the exhibitor pointing out that the colour mimicry in this species could not be due to parasitism, both Panurgus and Eriades being industrious genera.—A ♂ specimen of the earwig *Forficula auricularia* taken at Warwick in September last, with a drawing of the cerci (forceps), which were very abnormal, the broader basal part of the two appearing to be more or less fused together, while the legs of the forceps also were jointed to the basal part: W. J. **Lucas**.—Various interesting insects from Guatemala recently received from Señor Rodriguez, including *Heterosternus rodriguezi*, Cand., *Pantodinus klugi*, Burm., *Plusiotis adelaida*, Hope, and a species of Orthopteron greatly resembling a dead withered leaf, possibly a new species of Mimetica: G. C. **Champion**.—Two species of Coleoptera new to the British

Islands, *Loemophilus monilis*, F., taken in the neighbourhood of Streatley, Berks, and *Dacne fowleri*, n.sp., from Bradfield, with specimens of *D. humeralis* and *D. rufifrons* for comparison: Norman H. **Joy.**—A specimen of a new Agathidium discovered last year in Cumberland, and now taken by the exhibitor in Durham, and a series of *Prionocyphon serricornis* from the New Forest with a drawing of the larva, which he had found under water in the boles of trees, but appeared to emerge for pupation and descend into the ground: H. St. J. **Donisthorpe.**—Preparations of the scents of some African butterflies collected with the assistance of Dr. G. B. Longstaff during the recent visit of the British Association, together with examples of the species investigated: Dr. F. A. **Dixey.**—*Papers.*—A contribution towards the knowledge of African Rhopalocera: P. I. **Lathy.**—A new species of the hymenopterous genus Megalyra, Westwood: J. Chester **Bradley,** Ithaca, N.Y., U.S.A.

Linnean Society, November 2.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Exhibition of the tails of trout and grayling to show the heterocercal origin of the homocercal tail, by means of the hypural bones which balance the vertebra turning upward towards the upper lobe: Rev. G. **Henslow.**—Plant œcology, interpreted by direct response to the conditions of life: Rev. G. **Henslow.** Plant geography and plant surveying—that is, phytotopography—comprise records of the fluctuating distribution of species within definite areas, and associations, the result of natural selection. Œcology proper, or the physiology of plant geography, imply what has been defined by Prof. Tansley as "the study of the vital relations of organisms to their environment." These include the origin of adaptive structures, as varietal, specific, and generic characters, by means of the protoplasmic response to what was formulated by Darwin as "the direct action of the conditions of life, leading to definite results, whereby new subvarieties arise without the aid of natural selection."

Royal Microscopical Society, November 15.—Mr. G. C. Karop, vice-president, in the chair.—Lucernal and solar microscopes by Adams presented to the society: W. E. **Baxter.**—Focusing magnifier made by Messrs. Taylor, Taylor and Hobson: Dr. **Hebb.** The magnifier was a small photographic auxiliary intended for focusing purposes, being placed against the ground-glass screen of the camera to magnify the image and examine its definition.—A new turntable invention: A. **Flatters** and W. **Bradley.** The turntable was driven by clockwork, and was designed for turning oval cells and ringing oval mounts of any proportions from 0″ to $3'' \times 1\frac{1}{4}''$. By the use of the instrument it was also possible to run a ring round a needle point, strike a straight line, or turn circles.—Exhibition of dissections of the tsetse-fly and its trypanosomes: W. **Baker.** Mr. Baker said that, in addition to the slides illustrating the anatomy of the tsetse-fly, there was a specimen of the larva of Ochromyia, also from Africa, together with the perfect insect. The larva lives in the sandy earth, and attaches itself to the flesh and sucks the blood of the natives, causing very troublesome wounds. There was likewise a specimen of the ova of *Schistosoma sinensis* found in the body of a Chinaman who died at Singapore.

Chemical Society, November 16.—Prof. R. Meldola, F.R.S., president, in the chair.—Condensation of ketones with mercury cyanide: J. E. **Marsh** and R. De Jersey **Fleming-Struthers.** Acetone added to a solution of mercury cyanide in aqueous caustic soda gives a white precipitate, $Hg_4C_5H_4ON_2$, which dissolves on further addition of acetone. The reaction forms a good test for acetone applicable in presence of alcohol. The reaction appears to be confined to ketones containing the group $.CO.CH_3$.—Silicon researches, part ix., bromination of silicophenylimide and -amide, and formation of a compound including the group (SiN): J. E. **Reynolds.** Silicotetraphenylamide interacts quite regularly with about six atomic proportions of bromine in benzene. In the first stage bromine removes one of the aniline residues, and there remains a substituted guanidine in solution. This is then attacked with the formation of a soluble di-substituted di-imide. The substituted di-imide finally reacts with one molecular proportion of bromine, giving the compound $SiN.C_6H_3Br_2$.—Application of the microscopic method of molecular weight determination to solvents of high boiling point: G. **Barger** and A. J. **Ewins.** The apparatus used with low boiling solvents is modified by the addition of a "hot stage," whereby the tubes can be maintained at about 90° C.—Green compounds of cobalt produced by oxidising agents: R. G. **Durrant.** The conclusions arrived at are that these substances most probably all contain the nucleus $=Co.O.Co=$, on the persistence of which depends the green colour.—Dunstan, Jowett and Goulding's paper on "the rusting of iron": E. **Divers.** The author rejects the "hydrogen peroxide" theory of rusting advanced by Dunstan and his collaborators, and suggests instead that the active agents are the oxygen and the hydroxyl ions present in the water, the action being represented thus, $(O_2+2H.HO)+4Fe+2O_2=4HO.Fe:O$. In reply, Prof. Dunstan pointed out that the view expressed by Dr. Divers is not intelligible unless it amounts to what is virtually the hydrogen peroxide theory, which accounts for the inhibiting effect of potassium dichromate, as well as of alkalis, on the formation of iron rust in presence of water and oxygen.—Researches on the freezing points of binary mixtures of organic substances; the behaviour of the dihydric phenols towards *p*-toluidine, α-naphthylamine, and picric acid: J. C. **Philip** and S. H. **Smith.** The freezing-point curves indicate the existence of several new compounds of the above substances. These are shortly described.—Synthesis of tertiary menthol and of inactive menthene: W. H. **Perkin,** jun.—The synthetical formation of bridged rings, part ii., some derivatives of di*cyclo*butane: W. H. **Perkin,** jun., and J. L. **Simonsen.**—Optically active reduced naphthoic acids, part i., dextro-$\Delta^{2(\text{or } 3)}$-dihydro-1-naphthoic acid: R. H. **Pickard** and A. **Neville.**—Hydrizino-halides derived from oxalic acid: D. A. **Bowack** and A. **Lapworth.**—The action of nitrogen sulphide on organic substances, part iii.: O. C. M. **Davis.** The investigation of the action of nitrogen sulphide on the aldehydes has been continued, and it has been found that the reaction is not so general as was expected.—The action of nitrogen sulphide on organic substances, part iv.: F. E. **Francis.** Nitrogen sulphide acts on acetic and propionic acids at their boiling points with the liberation of sulphur dioxide and smaller quantities of nitrogen, and the formation of the corresponding amides and di-amides.—Tetrazoline, part iii.: S. **Ruhemann** and R. W. **Merriman.**

CAMBRIDGE.

Philosophical Society, October 30.—Prof. Marshall Ward, president, in the chair.—On a well-sinking at Graveley, near Huntingdon: Rev. O. **Fisher.** Graveley is in an extreme western corner of Cambridgeshire. The well is 154 feet above O.D. It was begun in the spring of 1905 in Boulder-clay, which proved to be 50 feet thick. The Oxford-clay was then encountered and pierced through 252 feet. A bed of Oolitic Limestone was next met with, and punched through a foot and a half. Another foot of clay brought the auger to a second bed of rock, and no supply of water having been obtained, the work was abandoned.—On a portable gold-leaf electrometer for low or high potentials, and its application to measurements in atmospheric electricity: C. T. R. **Wilson.** The electrometer has an outer and an inner case; the latter is maintained by means of a quartz Leyden jar at a positive potential which gives a convenient deflection when the gold leaf is earthed; about 60 volts is generally convenient. If the potential of the inner case is called V, then the instrument is suitable for measuring potentials, positive or negative, in the neighbourhood of zero, and also positive potentials differing by not more than a few volts from 2V. The displacement of the leaf for a change of potential of 1 volt is the same in either case. For convenience in charging the gold leaf to any desired potential, and for other purposes, there is attached to the instrument a small cylindrical condenser of variable capacity, consisting of a sliding tube kept at a constant negative potential by means of a quartz Leyden jar and a rod concentric with the tube fixed to the terminal of the gold leaf. The instrument may be applied to the study of the atmospheric potential gradient at the earth's surface and the earth-air current.

—Contributions to the knowledge of the tetrazoline group: S. **Ruhemann** and R. W. **Merriman**. The authors have continued the study of tetrazoline (see *Trans. Chem. Soc.*, 1902, lxxxi., 261) especially with the view of determining the constitution of the two compounds (previously described) which are formed by the action of methyl iodide on tetrazoline. They show that the one substance, $C_3H_7N_4I_3$, is the additive compound of the other, $C_3H_7N_4I$, and point out the resemblance between the former compound and the additive product of diazobenzene chloride with iodine.—The action of radium and other salts on gelatin: W. A. D. **Rudge**. The author has made experiments with various metallic salts, and finds that those of barium, lead, and strontium produce effects upon sterilised gelatin exactly similar to that caused by radium preparations, and comes to the conclusion that the "growth" observed is not of vital origin, and that the effect obtained by the radium salt is probably due to the large proportion of barium which it usually contains.—A suggestion as to the nature of the "walnut" comb in fowls: W. **Bateson** and R. C. **Punnett**.—The absence of isomerism in substituted ammonium compounds: H. O. **Jones**.

EDINBURGH.

Royal Society, November 6.—Prof. Crum Brown, vice-president, in the chair.—The conductivity of concentrated aqueous solutions of electrolytes, part i.: Prof. J. **Gibson**. When the ratio of the specific conductivity to the concentration measured in grams equivalent per cubic centimetre was plotted against the concentration, curves were obtained concave upwards. When, however, the concentration was measured in grams equivalent per gram, the corresponding graphs became in many cases accurate straight lines, and in most others straight lines over a considerable range of concentration. The point of maximum conductivity, when determinable, lay within this straight line portion. There were a few exceptions to the rules just stated. For example, the graph for zinc chloride was nowhere straight, but was concave upward.—The Tarpan and its relationship with wild and domestic horses: Prof. **Ewart**. The paper was a contribution to the important and difficult question of the ancestry of our domestic breeds of horses. The Tarpan, first described by Gmelin about 1740, had usually been considered as the wild ancestor of the horses of Europe; Dr. Nehring regarded it as the last survivor of the prehistoric European horse, modified by infusion of domestic blood, while Pallas and others thought it might very well be the offspring of escaped domestic horses. After a comparison of the characteristics as to hair, tail, mane, and skeleton of Tarpan and other breeds, Prof. Ewart proceeded to describe the result of his recent experiments on cross-breeding. Bearing in mind the fact established by previous experiments, that the crossing of carefully selected forms sometimes reproduced remote types in all their original purity, he selected a Shetland pony mare which seemed to be a blend of at least three varieties, resembling the wild horse of the Gobi Desert in the head, the forest variety in the mane, tail, and trunk, and the Celtic pony in the limbs and hoofs. This mare was crossed with a black Welsh pony. The first foal failed to throw any light on the question, but the second foal had developed into an animal, now three years old, which was as typical a Tarpan as ever roamed the Russian steppes. The general conclusion was that the Tarpan, once so common in the east of Europe, could not be considered as a true wild species, but was very probably derived from at least three sources:—(1) from a variety of Celtic pony; (2) from a variety resembling the forest horse (*Equus caballus typicus*); (3) from a variety identical with, or closely related to, the wild horse of Central Asia (*E. caballus prjevalskii*).—The horse in Norway: Dr. F. H. A. **Marshall**. The horses in Norway belonged to two distinct types, represented by the pure fjord horse and the Gudbrandsdal horse. The former was probably by origin identical with Prof. Ewart's "Celtic pony," while the latter belonged to the forest or cart-horse type. The fjord horse was now, as formerly, typically light dun in colour. The Gudbrandsdal was formerly of almost the same colour, but it was now generally dark brown or black, owing to an infusion of Danish and other foreign blood. The two types of Icelandic horses were derived respectively from the ancestors of the fjord horse and of the Gudbrandsdal horse.—Elimination in the case of equality of fractions whose numerators and denominators are linear functions of the variables: Dr. Thomas **Muir**. The investigation led with great ease to an interesting identity between a determinant of the $(n+1)$th order the constituents of which were determinants of the nth order and one of the nth order the constituents of which were of the $(n+1)$th order, an identity which would be difficult to establish directly.

PARIS.

Academy of Sciences, November 20.—M. Troost in the chair.—Researches on the insoluble alkaline compounds contained in living plant tissues: M. **Berthelot**.—On the Thalassinidæ collected by the *Blake* in the Gulf of Mexico: E. L. **Bouvier**. This group of crustaceans occupies an important place in the deep-sea collections made by the *Blake* expedition. Several new species are described.—On the attitudes of some Tertiary animals of Patagonia: Albert **Gaudry**.—The evolution of terrestrial relief: A. **de Lapparent**.—On the impossibility of negative waves of shock in gases: P. **Duhem**. Remarks on a paper on the same subject by M. G. Zemplén.—On the grains of Sphenopteris: M. **Grand'Eury**.—On the observation of the total eclipse of the sun of August 30, 1905, at Alcosebre, Spain: G. **Millochau**. A *résumé* of results obtained with the telespectrograph.—Interpolation formulæ for continuous periodic functions: Maurice **Fréchet**.—On the development in continued fractions of the function $(F(h, 1, h', u)$, and the generalisation of the theory of spherical functions: H. **Padé**.—On a theorem of M. Poincaré relating to the motion of a heavy solid: Édouard **Husson**. A new demonstration of this theorem is given.—On the application of the partial liquefaction of air with a view to the complete separation of the air into pure oxygen and nitrogen: Georges **Claude**. Details are given of a system of fractional distillation of liquid air. From 100 parts of air, about 14 parts of pure oxygen are obtained by the process originally described by the author. The improvements in the apparatus now described permit of a practically complete separation of the two gases.—The density of nitric oxide; the atomic weight of nitrogen: P. A. **Guye** and Ch. **Davila**. The nitric oxide used in these experiments was prepared by three methods, the action of mercury upon sulphuric acid containing nitrous fumes, the reduction of nitric acid by ferrous sulphate, and the decomposition of sodium nitrite by sulphuric acid in dilute solution. The gas was dried by sulphuric acid and phosphoric anhydride, solidified in liquid air, and purified by fractional distillation. The mean density found was 1·3402 grams per litre, practically identical with the value recently found by Gray—1·3402. This leads to a value for the atomic weight of nitrogen between the limits 14·006 and 14·010, a confirmation of the number 14·009 found in previous researches.—The action of chloride of silicon on iron: Em. **Vigouroux**. Silicon chloride is decomposed by iron a little below a red heat. No lower chloride of silicon appears to be formed, the silicon set free forming an alloy with the iron containing about 20 per cent. of Si, corresponding to the formation of the well known compound Fe_2Si.—On the preparation of racemic amyl alcohol: P. **Freundler** and E. **Damond**. The alcohol is prepared by the interaction of trioxymethylene with the magnesium compound of secondary butyl bromide, details being given of the precautions necessary to obtain a good yield.—The diffusion of barium and strontium in the sedimentary strata: L. **Collot**.—On the increase in the dry weight of green plants developed in the light, in the absence of carbon dioxide, in a soil to which amides have been added: Jules **Lefèvre**. It has been shown experimentally that the growth of green plants in a soil containing amides, and in the absence of carbon dioxide, is accompanied by a rapid increase in the dry weight. The growth under these conditions is therefore real, and not merely a phenomenon of hydration.—On the structure and evolution of *Rhacodium cellare*: F. **Guéguen**.—On juglone: M. **Brissemoret** and R. **Combes**. Contrary to the usually accepted view, it is shown that juglone exists already formed in all the green organs of the walnut (leaves, stem, nut). The method used for the extraction is given in detail.—Rheotropism in some hydroids and Bugula: Paul

Hallez.—The influence of high altitudes on the general nutrition: H. **Guillemard** and R. **Moog.** The observations were carried out at Paris, at the Grand Mulets (3050 metres), and the summit of Mt. Blanc (4810 metres), the changes in the urine being more specially examined. It was found that the effect of high altitudes on nutrition was to produce a diminution of the oxidation processes, diminution of diuresis, and retention of the fixed elements.—The spleen and the biliary secretion: N. C. **Paulesco.** Experiments on dogs leads to the conclusion that the spleen exercises no apparent influence on the formation of bile.—Researches on the formation of hæmoglobin in the embryo: L. **Hugounenq** and Albert **Morel.**—The aurora borealis of November 15 and the magnetic disturbances of November 12 and 15: Th. **Moureaux.** The appearance of the aurora corresponded to strong magnetic disturbances.—Observations on atmospheric electricity in Grahamsland: J. **Rey.**

DIARY OF SOCIETIES.

FRIDAY, DECEMBER 1.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Installation for the Bacterial Treatment of Sewage, at Neath: W. L. Jenkins.

GEOLOGISTS' ASSOCIATION, at 8.—*Gazella Daviesii*—A New Antelope from the Norwich Crag of Bramerton: M. A. C. Hinton.—On Sections of the Holocene Alluvium of the Thames at Staines and Wargrave: A. S. Kennard and B. B. Woodward.

MONDAY, DECEMBER 4.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Exploration in the Abai Basin, Abyssinia: H. Weld Blundell.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Notes on Gutta Percha and Balata: Dr. W. A. Caspari.—The Determination of Zinc in Zinc-Aluminium Alloys: Dr. R. Seligman and F. J. Willott.—Distilled Water Supply for "Works' Laboratories: Dr. R. Seligman.—The Estimation of Naphthalene in Coal Gas: C. J. Dickinson-Gair.—Salts of the Alkaloid Cinchonamine: B. F. Howard and F. Perry.

SOCIETY OF ARTS, at 8.—The Measurement of High Frequency Currents and Electric Waves: Prof. J. A. Fleming, F.R.S.

TUESDAY, DECEMBER 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Steam-Turbine: Hon. C. A. Parsons, C.B., F.R.S., and G. G. Stoney.

WEDNESDAY, DECEMBER 6.

GEOLOGICAL SOCIETY, at 8.—The Physical History of the Great Pleistocene Lake of Portugal: Prof. E. Hull, F.R.S.—The Geological Structure of the Sgurr of Eigg: A. Harker, F.R.S.—The Buttermere and Ennerdale Granophyre: R. H. Rastall.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of new Genera and Species of African Galerucidæ and Halticidæ: M. Jacoby.

SOCIETY OF ARTS, at 8.—The Manufacture of Sugar from British-grown Beet: Sigmund Stein.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Reducing Action of Hydrogen, II., The Estimation of Traces of Arsenic by the Marsh-Berzelius Method, and the "Insensitiveness" of Zinc: A. C. Chapman and H. D. Law.—Note on the Removal of Arsenic from Hydrochloric Acid for Use in the Marsh-Berzelius Method: A. R. Ling and T. Rendle.—Note on Dutch Cheese: C. H. Cribb.—Improved Arrangement of Lenses for Reading Balance Graduations: G. T. Holloway.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—The Periodogram and its Optical Analogy; with an Illustration from a Discussion of Observations of Sun spots: Prof. A. Schuster, F.R.S.—(1) On a Property which holds good for all Groupings of a Normal Distribution of Frequency for two Variables, with Applications to the Study of Contingency-tables for the Inheritance of Unmeasured Qualities; (2) On the Influence of Bias and of Personal Equation in Statistics of Ill-defined Qualities: an Experimental Study: G. Udny Yule.—On the Inheritance of Coat-colour in Horses: C. C. Hurst.—A Biometrical Study of Conjugation in Paramæcium: Dr. Raymond Pearl.—On Mathematical Concepts of the Material World: A. N. Whitehead, F.R.S.—The Determination of the Osmotic Pressure of Solutions by the Measurement of their Vapour Pressures: The Earl of Berkeley and E. G. Hartley.—The Vertical Temperature Gradients on the West Coast of Scotland and at Oxshott, Surrey: W. H. Dines, F.R.S.—The Combination of Hydrogen and Oxygen in contact with Hot Surfaces: Dr. W. A. Bone, F.R.S., and R. V. Wheeler.

SOCIETY OF ARTS, at 4.30.—The Partition of Bengal: Sir James A. Bourdillon, K.C.S.I.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Nitrites, Part I., Two Varieties of Silver Nitrite: P. C. Rây and A. C. Ganguli.—The Products of Heating Silver Nitrite: E. Divers.—Ethyl Piperonylacetate: W. H. Perkin, Jun., and R. Robinson.—A Contribution to the Chemistry of Saccharin: F. D. Chattaway.—The Action of Heat on α-Hydrocarboxylic Acids, Part II.: H. R. Le Sueur.—Studies on Optically Active Carbimides, Part II., The Reactions between 1-Menthylcarbimide and Alcohols: R. H. Pickard, W. O. Littlebury, and A. Neville.—The Action of Ultra-violet Light on Moist and Dried Mixtures of Carbon Monoxide and Oxygen: S. Chadwick, J. E. Ramsbottom and D. L. Chapman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Concrete Mixers: Dr. J. S. Owens.

LINNEAN SOCIETY, at 8.—On the Ætiology of Leprosy: Dr. Jonathan Hutchinson, F.R.S.—Some Notes on the Life history of *Margaritifera Panesene*: A. W. Allen.—*Exhibition*: Photographs of a Luxuriant Specimen of *Shortia uniflora*, in the Rock-garden of Mr. W. T. Hindmarsh, at Alnwick.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—(1) A Revision of the Species of Cyclostomatidæ and Liotiidæ occurring in the Persian Gulf and North Arabian Sea; (2) Description of Two Species of Marine Shells from Ceylon: J. Cosmo Melvill.—A Pteropod Alias: (*a*) C. Hedley. (*b*) E. R. Sykes.—(1) Descriptions of Four new Species of Marine Shells from Ceylon; (2) Description of a new Species of Physa from N.W. Australia: H. B. Preston.—Notes (1) on the Dates of Publication of J. D. Wilhelm Hartmann's "Erd- und Süsswasser-Gasteropoden," 8vo, St. Gallen, 1840; (2) On Some "Feeding Tracks" of Gastropods; (3) On Cement as a Slug-killer: B. B. Woodward.

CONTENTS.

THURSDAY, DECEMBER 7, 1905.

THE PRINCIPLES OF HEREDITY.

The Principles of Heredity, with Some Applications. By G. A. Reid. Pp. xiii+359. (London: Chapman and Hall, Ltd., 1905.) Price 12*s*. 6*d*. net.

THE publication of this book marks an epoch in the history of the relation between medicine and biology, inasmuch as it is an embodiment of the recognition by medical men that they depend ultimately for a precise knowledge of nature on the professional biologist who may or may not, at the same time, be a medical man.

The book should be welcomed by doctors as containing, in the earlier chapters a straightforward though rather brief account of theories of organic evolution, and by biologists as giving a very full account of the medical aspect of these problems, and by both as an interesting collection, under the title of "The Principles of Heredity," of a mass of information and ideas connected with that phenomenon.

The reader may object to the antithesis between medicine and biology, but will, we hope, withdraw his objection when it is explained that all that is meant by it is the antithesis between applied and pure biology.

The recognition by medical men of the value to them of the information with which the biologist is able to supply them is unquestionably a good thing; yet it is a curious illustration of the fact that a new movement of opinion cannot stand isolated and alone, cannot be without consequences of one kind or another, that one result of the popularity of the *entente* between the doctor and the biologist may prove harmful to biology, and through it perhaps ultimately to medicine.

The danger is that the biologist, pure and simple, the man who works at his subject for the mere joy of investigation and discovery, may cease to exist. So many workers of this type are becoming applied biologists, whether they be sporozoologists devoting themselves to malaria, students of heredity to eugenics, or cytologists to cancer. We do not, of course, complain of the application of biological knowledge; it is obviously fitting and right that as much use should be made of it as possible. But we do complain loudly of the opinion that the application of such knowledge is, or should be, the ultimate goal of him who acquires it. Huxley strongly insisted on the fact that the fruits, useful to mankind, of the tree of natural knowledge fell unsought for and unexpected on the back of the head of some obscure worker under its shade, and never to him who worked there with outstretched palm. Dr. Reid says, p. 331,

"Hitherto the nature of their training has tended to render medical men excessively conservative. Nevertheless they have already assimilated and put to magnificent practical use one of the two great scientific achievements of the age—Pasteur's discovery of the microbic origin of disease. The other great achievement, Darwin's discovery of the adaptation of species to the environment through natural selection, has hardly been assimilated, and certainly put to no practical use as yet. Both these discoveries should have been made by medical men."

The fact that they were not is an illustration of the truth of Huxley's words.

Let it be emphasised again that we do not hold that the gradual desertion of biologists from the ranks of the pure to those of the applied is other than of the greatest service to mankind. But if this desertion means that the opinion that the natural goal of the young biologist is to obtain a position in applied biology will grow, it is a bad thing for science. So that even if it is only on the ground that the utilitarianism which may lead to the extinction of the pure biologist is a bad one, it is to be deplored. If we are going to be utilitarians let us at least be good ones, and let us recognise the demonstrable fact that the only way in which the knowledge and consequent control of nature can be acquired is by encouraging the existence of the type of man who works at his subject for its own sake. Let us have less of the talk about the profound significance of such and such a branch of investigation to the sociologist and the statesman and more of the frame of mind which finds expression in Bateson's words:—"We are asked sometimes, Is this new knowledge any use? That is a question with which we, here, have fortunately no direct concern. Our business in life is to find things out, and we do not look beyond."

With regard to this utilitarianism Dr. Reid appears to us to steer the right course in his book, except, perhaps, that he sails rather too near it when, pointing out that a classical education is inefficient and does not make us like the Greeks and Romans, he says,

"the true modern representatives of the great Pagans are not to be found in college halls or country parsonages, but in thinkers and workers like Darwin, Huxley, Kelvin, Cecil Rhodes, the strenuous men who rule Egypt and India. . . ."

Surely the patient inquiring spirit which prompts a man to devote himself to classics is the same as that in the heart of the true man of science. One of the greatest steps forward in the study of heredity itself was made by a monk.

Dr. Reid's book is tolerably free from that looseness in the use of scientific terms which is common enough in purely scientific works, but which is simply rampant in books on popular science.

The reader who wishes to familiarise himself with the subject of heredity should be very careful to distinguish between the two meanings of the term regression, the one which is a purely biological phenomenon and the other which is a purely statistical conception. With regard to the use of that much-abused word "law," our author makes a statement that at first sight seems to show that he has not thought very seriously about the meaning of that

word. But we do not believe our author wishes to be taken seriously here:—

"Even if we postulate a Deity as the Originator of all things, yet the whole history of science, which is that of civilisation, proves that it is more profitable to seek the *explanation of natural phenomena in natural laws* (*His laws*) *than in infractions of them*—in miracles." (The italics are mine.)

We have one fault to find; in a work on the principles of heredity one would have expected a fuller discussion than is actually given of biometric and Mendelian methods of dealing with that phenomenon: medical men reading the book will get a very meagre idea of the nature of the investigation being carried on and of the definite results already achieved by these two sets of workers.

Dr. Reid does good service in dealing a blow at that teleology which is the curse of biological science by exposing the falsity of the old idea that the "object" of bi-parental reproduction is to ensure a sufficient degree of variability in each generation for natural selection to operate upon. He cites as evidence for this Dr. Warren's work on *Daphnia magna*; but does not refer to a more recent and more complete demonstration of the same truth by the same author in the case of Aphis, to be found in *Biometrika*, vol. i., p. 129.

These, however, are trifles, and do not detract from the value of the book as a whole. A. D. D.

MATHEMATICAL LECTURES FOR AMERICAN MATHEMATICIANS.

The Boston Colloquium. Lectures on Mathematics. By Edward Burr Van Vleck, Henry Seely White, and Frederick Shenstone Woods. Pp. xii+188. (New York: The Macmillan Company, 1905.) Price 2 dollars net.

Lectures on the Calculus of Variations. By Dr. Oskar Bolza. Pp. xvi+272. (Chicago: The University Press, 1904.) Price 4 dollars net.

AMONG the many ways in which the American Mathematical Society has endeavoured to popularise and develop the study of higher mathematics, not the least remarkable and useful is the practice of holding "colloquia" in connection with the summer meetings at intervals of two or three years. It had been felt that the mere reading of a long string of disconnected papers does not produce much lasting impression on the minds of the audience. On the other hand, even a short course of university lectures will often adequately cover a wide range of mathematical study. The society therefore decided in 1896 to arrange for courses of three to six two-hour lectures, each dealing with a substantial part of mathematics. Four such colloquia have been held, at Buffalo in 1896, at Cambridge in 1898, at Ithaca in 1901, and at Boston in 1903. At each of the first three two courses of lectures were given, and Prof. Oskar Bolza's course on "The Simplest Type of Problems in the Calculus of Variations," given at the Ithaca colloquium of 1901, forms the basis of one of the two volumes before us. The chapters nearly follow the historic order laid down in the introduction, which is also in close conformity with a logical sequence of treatment. The study of the first and second variations of an integral naturally leads to Weierstrass's examination of the conditions for a minimum and the distinction between a "strong" and a "weak" minimum, a terminology introduced by Kneser. The next steps are represented by Weierstrass's theory of parameter representation, Kneser's general theory based on the properties of geodesics, and Hilbert's existence-theorem. For Weierstrass's work (much of which is contained in unpublished courses of lectures) the author has had recourse to his own notes of a course (by Weierstrass) which he attended in 1879, as well as to several other sets of lecture notes, including one on Prof. Schwarz's lectures at Berlin on the same subject.

At the next colloquium, held at Boston in September, 1903, three courses of lectures were given. The year marked the fiftieth anniversary of the appointment of Prof. John Monroe Van Vleck to the chair of mathematics at Wesleyan University, and it was fitting to the occasion that all the lecturers were Van Vleck's pupils, one of them being his son. Prof. Henry S. White, of North-Western University, is responsible for the course of three lectures on "Linear Systems of Curves on Algebraic Surfaces," Prof. Frederick S. Woods, of the Massachusetts Institute of Technology, for three lectures on "Forms of Non-Euclidian Space," and Prof. Edward B. Van Vleck, of Wesleyan University, for six lectures on "Selected Topics in the Theory of Divergent Series and Continued Fractions." A bibliography of literature on continued fractions extending over twenty pages concludes the last named discourse.

Long formulæ involving x and y are like little children—they ought to be "seen and not heard." The success of these colloquia when originally delivered must have been in some considerable measure due to the extent to which the authors have succeeded in dealing with ideas and their symbolical representations without giving tedious demonstrations *in extenso*.

INDUSTRIAL REFRIGERATION.

Modern Refrigerating Machinery, its Construction, Methods of Working, and Industrial Applications. By Prof. H. Lorenz. *American Practice in Refrigeration.* By H. M. Haven and F. W. Dean. Pp. x+396. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 17s. net.

IT is to be regretted that no treatise exists on this subject which contains an exhaustive investigation of the thermodynamical problems involved, and of the physical properties of the various gases used as media, with special reference to their practical application to refrigerating machinery. In works on thermodynamics, the matter is treated in general terms. The physical constants are found in scattered

tables, and even with such a well-known gas as carbon dioxide they have not been completely determined. It has become more and more necessary for the engineer or manufacturer to be familiar with the scientific researches and theoretical considerations which lie at the base of his industry, and Germany has come to be looked upon as the leader in fundamental work of this sort, but the "Neuere Kühlmaschinen" of Prof. Lorenz makes no pretence to be of this comprehensive character. While refrigerating machinery is sufficiently simple, the principles on which it is based are not so easy of comprehension to the working engineers and business men who use it industrially. As a handbook for men of this class and as a *résumé* of the subject, this manual has long been known in Germany and on the Continent. Various editions have been published as a volume of the "Technische Handbibliothek," and the present translation under the title of "Modern Refrigerating Machinery" is from the edition of 1901.

No space is taken up by a historical introduction, but after some pages of an elementary character on the principles of heat there follows a chapter on "Methods of Cold Production," which gives a well arranged and concise description of the manner in which refrigeration is produced by different methods and of the energy required. The chapter on compressors treats chiefly of the important details of the machines, and wisely does not touch upon matters which belong more properly to generic and not to special machine design, and has some instructive indicator diagrams. The chapters which follow deal with condensers and evaporators, the cooling of liquids and air, and the manufacture of ice. They describe clearly the chief features of the matter under discussion, and do not enter upon general descriptions from which it is difficult to decipher the essential points. The pages devoted to very low temperatures, written four years ago, have now become merely of historical interest. The final chapter, on the performance of refrigerating machines, or, as the translator calls it, "The Yield of Cooling Machines," contains the only higher mathematics in the book, which contrast rather strangely with some of the simple definitions at the beginning. The translation is poor. The German original is closely followed. Such sentences as "tightness towards gases requires, besides faultless material, as small a number as possible of tubulures and stuffing boxes" are not very clear to an English mechanic, nor does the constant use of italics for the more important words add to the attractiveness of the pages. The illustrations are numerous and excellent, and the cuts are superior to those in the German edition.

In the same volume, though the pages are numbered consecutively, is a separate work on "American Practice in Refrigeration." It contains some admirable illustrations and useful data in regard to the construction of cold storage rooms, but it is not quite apparent what purpose the American authors could have in view in reprinting tables from such well-known books as those of Siebel and Wallis-Tayler.

C. H. B.

OUR BOOK SHELF.

The Geography of New Zealand. By P. Marshall. Pp. x+401. (Christchurch, N.Z., and London: Whitcombe and Tombs, Ltd., n.d.)

THE author claims to have written "according to the spirit of the New Geography," to give due consideration to the influence that the relief of the land has upon the circulation of the atmosphere, the climate, the distribution of flora and fauna, and the settlement of population; he explains that the latter is influenced considerably by the distribution of mineral deposits, while the nature of the industries affects the commerce of the country and shapes its political institutions.

The work is for this purpose divided into three parts, under the headings (1) historical, (2) physical, (3) political and commercial. There is a valuable introduction by Prof. Gregory, and an important chapter on geysers by the same writer, in which, however, he erroneously alludes to Strokur as being still an active geyser, whereas it ceased to erupt in 1895. The chapter on earthquakes by Mr. G. Hogben deserves special mention; the several kinds of earth movements and their registration by the seismograph are described. Of special interest to all lovers of Ao te Roa the unscientific reader as well as the geographical student—are the chapter on the Maoris, by Mr. A. Hamilton, and the descriptions of various unique natural beauties.

At times the style is very explanatory and the matter original. Occasionally the author's meaning is somewhat vague, as when he writes:—"the high mountainous land here reaches the sea, and is in fact truncated by it." But on the whole the information given is accurate and concise, and the arrangement throughout careful.

As stated in the preface, the book is not merely the result of the author's and his contributors' personal observation, but is a collection of facts and figures from the previous writings of acknowledged authorities on the islands of which it treats. The letterpress is profusely illustrated with maps, reproductions of photographs, sketches, and old prints. These are all interesting, and many of the sketch-maps serve well to illustrate the text.

M. G. B.

Wild Wings; Adventures of a Camera-Hunter among the Larger Wild Birds of North America on Sea and Land. By H. K. Job. Pp. xxv+341; illustrated. (London: A. Constable and Co., Ltd.; Boston and New York: Houghton, Mifflin and Co., 1905.) Price 10*s.* 6*d.* net.

DESPITE its somewhat pedantic title, this book is much above the average of works of the same general nature, and deserves a wide circulation, if only on account of the earnest plea made by its author that the camera may, at least to some extent, be substituted for the shot-gun in our intercourse with birds. In this laudable endeavour he is supported by the President of the United States, who, after stating that wild-game shooting, under proper restrictions and regulations, must be considered legitimate so long as we breed domesticated animals for slaughter, observes that "there is altogether too much shooting, and if we can only get the camera in place of the gun and have the sportsman sunk somewhat in the naturalist and lover of wild things, the next generation will see an immense change for the better in the life of our woods and waters."

The special feature of Mr. Job's book is undoubtedly formed by the illustrations, all of which, we are told, are reproductions—and very excellent ones—of photo-

graphs taken by the author himself. In a country of the size and extent of America, with climates ranging from the arctic to the tropical, and with large tracts of more or less untrodden wastes, the bird-lover and photographer has, of course, vastly greater opportunities (especially among the larger species, to which the author has confined his attention) than his brother in our own islands, and it must be confessed that these opportunities have not been neglected, for a more delightful book, both as regards text and illustrations, it would be difficult to produce.

The breeding colonies of brown pelicans of New England must form a really marvellous sight. On the occasion of the first visit of the author and his party, the boat was run ashore without alarming the birds. "Then," writes the narrator, "we stood up and shouted, but hardly a bird rose. There they sat upon their nests, hundreds and thousands of them, many within forty or fifty feet, solemnly gazing at us. It was not until we sprang out upon the shore that there was any considerable flight, and even then we noticed that it occurred only within a radius of fifty or sixty feet, the rest of the colony remaining on their nests apparently in perfect unconcern." Time after time the colony has been raided by feather and egg hunters, but it is satisfactory to learn that Pelican Island has recently been made by President Roosevelt a Government reserve for wild birds.

Not less interesting is the author's account of the colonies of white ibises and Louisiana herons in the Cape Sable wilderness, this being followed by a fascinating description, with equally fascinating photographs, of the colonies of sooty terns and noddies on "Lonely Bird Key," in the Dry Tortugas group, far out in the Gulf of Mexico. But if we were to cite even a tenth of the passages to which we should like to refer, editorial limits would be far exceeded, and in bringing this brief notice of an admirable bird-book to a close we cannot do better than advise our readers to get copies for themselves.

Instruction in Photography. By Sir W. de W. Abney. Eleventh edition, revised. Pp. 676. (London: Iliffe and Sons, Ltd., 1905.) Price 7*s.* 6*d.* net.

THIS work, which for many years has held the premier position among English text-books of photography, is to a peculiar extent the record of the author's own experiments and investigations, and in the new edition much new matter on the subject of colour photography has been added, the product of the attention which Sir W. de W. Abney has devoted to that branch of photography for some years. In other sections of the book it may be noted that the descriptions of lenses are brought up to date, while the chapter on sensitometry includes a description of Mr. Chapman Jones's plate tester. An entirely new chapter has been added to the book entitled "The Failure of a Photographic Law," and including the well known experiments made by the author upon the effect of intermittent exposures and upon the failure of the reciprocity law. Here also will be found an interesting discussion of the effect of temperature upon the sensitiveness of plates, while the last part of the chapter is devoted to an account of the author's researches upon the effect of different monochromatic lights upon a plate. The book has been entirely reset, larger type being employed throughout and the printing generally improved. No alteration has been made in the theoretical views set forth, and the silver sub-bromide theory of the latent image is adopted in its entirety. C. E. K. M.

La Bobine d'Induction. By H. Armagnat. Pp. 228. (Paris: Gauthier-Villars, 1905.) Price 5 francs.

IN this book a very interesting account is given of the induction coil in its theoretical and practical aspects. The electromagnetic problems involved are clearly stated, and the various factors which stand in the way of a complete mathematical theory are considered in some detail. The effects of sparking at the interruptor, the parts played by the iron core, by the secondary capacity, &c., are carefully examined and methods of experimental investigation are illustrated. The differences between mechanical and electrolytic interruptors are discussed, and the more purely theoretical part of the book concludes with a chapter on the power and output of a coil and of the factors upon which these depend. The methods of measuring the electromagnetic constants of a coil are indicated, as are the most common sources of breakdown, how they may be detected, and how in some cases remedied.

In the description of the practical construction of coils which follows, the different methods of winding, insulation, &c., are described in detail, and the relative dimensions of the various parts of coils of standard makes are given. The particular features of different types of interruptors, mechanical and electrolytic, upon which efficient working depends are stated clearly (although the action of the commonest mechanical interruptor is not quite so simple as it is made to appear, and might perhaps have been described in greater detail in a book of this kind).

The principles of the action of several special forms, such as Tesla's, of induction apparatus used in practice are given in outline, and a final chapter is devoted to a description of the various uses of induction coils. The range of this chapter is perhaps indicated when it is said that it includes the discussion of such questions as the ignition apparatus of explosion-engines and the production of ozone.

A very useful bibliography, in which the references are in most cases accompanied by short abstracts, completes an excellent book.

Handbook of Metallurgy. By Prof. Carl Schnabel. Translated by Prof. Henry Louis. Second Edition. Vol. i. Copper—Lead—Silver—Gold. Pp. xx + 1123. (London: Macmillan and Co., Ltd., 1905.) Price 25*s.* net.

THIS volume is a translation of the second German edition which appeared in 1902. Prof. Schnabel has found it necessary to increase the length of the book considerably, the translation being 214 pages longer than that of the first edition. A number of new furnaces and other appliances are described, and in particular the account of the extraction of copper by electro-metallurgical methods has undergone great expansion. The older metallurgical methods are purposely dwelt on by the author, who gives as his reason that a knowledge of the development of metallurgy stimulates inventive genius. It is equally certain that the inclusion of the descriptions of out-of-date methods helps to make books bulky.

The merits and defects of the book remain much the same as in the first edition. It contains a mass of detailed information as to the dimensions of appliances in use at particular works, the analyses of products, and the like, but the discussion of the principles underlying the practice is generally less thorough. This is as much as to say that the book is "practical." Prof. Louis is to be congratulated on the translation, which makes a valuable work available to British students.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Second Law of Thermodynamics.

THE point which Mr. Browne (p. 102) raises is covered by Voigt ("Thermodynamik," vol. ii., § 69, pp. 209 *et seq.*). Ordinary diffusion of two gases at equal pressure and temperature is an irreversible process involving loss of available energy, but when the diffusion takes place through porous membranes this available energy can be utilised in a greater or less degree in the form of work, and this is the case in Mr. Browne's experiment. By introducing the conception of "semi-permeable partitions," Voigt obtains a reversible method of mixing or separating gases. In this case the partial pressure of the mixture is equal to the sum of the partial pressures of the components. In ordinary diffusion the volume of the mixture is equal to the sum of the volumes of the components. The work of expansion from the former to the latter final state can be utilised if a reversible transformation is employed. It is lost in the case of ordinary diffusion. An equal amount of work must, however, be supplied from without to separate the gases. The results are fully in accordance with the second law. G. H. BRYAN.

MR. M. A. BROWNE's letter (p. 102) raises an interesting and difficult question which at some period of his career must be faced by every student attempting to grasp for himself the significance of the second law of thermodynamics. As I, with difficulty and without much help from the text-books, extricated myself from a similar dilemma, perhaps the steps in the train of reasoning which helped me may interest others.

There is no need to take the complicated case chosen by Mr. Browne of the diffusion of hydrogen and nitrogen through a palladium septum. A precisely analogous difficulty exists in the simpler case of an ordinary cylinder of compressed gas doing external work on expansion either at the expense of its own heat or of the heat of uniform temperature of its environment. The gas expands and does an amount of external work W, while the equivalent H units of heat flow into the gas from the surroundings, so that the result of the process is that H units of heat at the uniform temperature of the surroundings have been quantitatively converted into external work. This is, no doubt, contrary to many of the earlier statements of the second law.

The test, of course, is to compress back the gas into the cylinder, when at least W units of work have to be converted back into heat during the process. Moreover, this must be done whether or not the gas did work on expansion. Although a gas expands freely into a vacuum, doing no work, and, as Joule has shown, experiencing no appreciable change of total energy in the process, to get it back again into the cylinder, at least W units of work must be converted into heat. I know of no better way of introducing thermodynamical considerations to the chemical student than by commencing with the concrete case of a gas cylinder. The extension of the same considerations to all processes naturally occurring, the flow of heat from a hot to a cold body, the diffusion of gases through septa, the change of one allotropic form of element into another, all follow as illustrations of the "majestic" and "universal" law that that mysterious something which is not energy, but an abstraction of energy—its availability for work—tends always to a minimum, or, as others have it, the entropy increases. The student passes his examination, no doubt, but if he is a philosopher he may prefer to meet his difficulties singly, and not have them "concentrated in a phrase." It is possible that he may like to think sometimes of a gas as expanding, because it is its nature to. The reason is easily understood on mechanical or kinetic considerations. But the attempt to replace these considerations by the two *ex cathedra* statements—(1) the entropy of a gas increases during increase of volume, (2) the entropy of the universe tends to increase—and to deduce from them the direction of natural tendency in the case of a gas changing in volume, seems to the writer to involve the thermodynamical equivalent of the fallacy of "putting the cart before the horse." We cannot escape mechanical and molecular considerations.

The University, Glasgow. F. SODDY.

Atomic Disintegration and the Distribution of the Elements.

WITH reference to the association of uranium and radium, would you permit me to put on record a point that must have occurred to many, though possibly not to some, of those who are speculating so brilliantly about uranium and its disintegration products. I refer to the extraordinary conjunction in nature between silver and lead. This conjunction is so frequent that it can hardly be casual. A lead mine is a silver mine and a silver mine a lead mine all the world over, and yet the chemical attraction between silver and lead is slight, and the two metals are not sufficiently common to concur by chance. It is to be noted also that the concurrence, if the word may be used in this sense, is usually of the order of ounces for silver and tons for lead, and that the atomic weight of lead is 207 and of silver 108. Hence there appears to be some ground for the suspicion that silver is a disintegration product of lead. Lead also happens to present special facilities for experiment to test this surmise. It is cheap, and it is a comparatively inexpensive matter to free ten tons of lead from all traces of silver by the usual crystallising process, and then put it aside for ten years and test again for silver by the same process.

There are several other curious groupings of elements in nature that seem to be worthy of consideration from the transmutation point of view. One of these is the frequent concurrence of copper and gold. In the Great Cobar copper mine in New South Wales the gold occurs in the ratio of about four ounces to the ton of copper. Such conjunctions as gold and quartz are, of course, easily explained by chemistry and coincidence, and chemical forces also sufficiently explain the concurrence of sulphur with silver and lead, but the giant deposits of silver, lead, and zinc, with smaller quantities of copper and still smaller quantities of gold at Broken Hill, in Australia, to say nothing of similar vast deposits in many other countries, can hardly be due entirely to chemical and casual forces. Anyone interested in the subject will find much statistical and other information in the annual report of the Broken Hill Proprietary Company. This document affords considerable food for reflection, and a visit to the mine itself is absolutely awe-inspiring. Walking through galleries of glittering grey crystals of silver, lead, and zinc sulphide—solid ore—for 300 feet *across* the lode, which is a mile or more in length and of unknown depth, is one of the experiences of a lifetime. DONALD MURRAY.

3 Lombard Court, London, E.C., November 30.

Zoology at the British Association.

IN your account, under the above heading, of the proceedings of Section D of the British Association at Johannesburg, you state (p. 40) that in my paper on Cephalodiscus I "gave a preliminary account of the new species discovered in African seas by Dr. Gilchrist."

I shall be obliged if you will allow me to say that my communication to Section D consisted of an abstract of the results which were published, last July, in my report on "The Pterobranchia of the *Siboga* Expedition," and that it did not include any account of Dr. Gilchrist's specimens of Cephalodiscus. S. F. HARMER.

King's College, Cambridge, November 14.

[Our contributor was unfortunately engaged in the committee room during Dr. Harmer's introductory remarks, and this led to the misunderstanding to which Dr. Harmer directs attention.—EDITOR.]

THE THOROUGHBRED HORSE.[1]

THE re-discovery of the so-called *Equus przewalskii*, or Mongolian wild pony, has during the last few years awakened renewed interest in the puzzling question of the origin and ancestry of our domesticated breeds of horses and their relations to their wild or semi-wild representatives, and workers on both sides of the Atlantic have been doing their best, with results more or less satisfactory (at least to themselves), to solve the problem. The subject, like an apparently impregnable fortress, has been attacked from several sides at once, in the hope that if one plan fails another may succeed; and while one worker has endeavoured to solve the mystery by the study of apparently vestigial structures, a second relies on cross-breeding, while a third believes that external characteristics are alone sufficient to decide the question. Prof. Ridgeway, on the other hand, has primarily attacked the problem from the point of view of the historian and the archæologist, and it must be acknowledged that naturalists owe him a large debt of gratitude for bringing into prominence lines of evidence with which, from the very nature of the case, they are unfamiliar. Apparently, however, the author soon discovered that salvation was not to be found from archæological investigations alone, and that it was essential for him to enter in some detail into the natural history of *Equus caballus* and its allies. To one who has thus been compelled by force of circumstances to enter on paths of study other than his own, tender treatment should be accorded by the critic, and especially should this be so in the present instance, when the author has called to his assistance at least two naturalists who have specially studied the Equidæ.

FIG. 1.—Norwegian ponies, as examples of the typical dun type of the horse. From Ridgeway's "The Thoroughbred Horse."

As regards the two introductory chapters on the horse family in general, a very large proportion has little or no bearing on the subject, and might advantageously have been omitted. As it stands, it is to a great extent inaccurate and misleading. If, for instance, the list of existing Equidæ on p. 12 be compared with the descriptions of species and races later on, numerous discrepancies will be found. As an example we may refer to the mention of the chigetai, or dzeggetai (*Equus hemionus*), and of the kiang (*E. hemionus kiang*) on pp. 44 and 45, and the complete omission of the former on p. 12, where the latter is quoted as *E. kiang*. The difference between species and subspecies is, however, a great stumbling block to the author, as may be inferred from p. 61, where it is stated that "certain zebras have been made into subspecies by some, though there is no evidence that they are more than local races," and we are left in pleasing uncertainty whether the wild Mongolian pony is a species by itself or a race of *Equus caballus*. In connection with this part of the subject, the omission of any reference to the present writer's latest paper (1904) on wild asses, when his earlier ones are quoted, is noticeable, as is also the statement (p. 143) that he has sought to establish a relation between the ponies of Java and Sulu and *E. sivalensis*. Perhaps too much is also made of the expression "an Indian domesticated horse" in reference to a certain skull (pp. 159 and 470) in the British Museum, which probably belonged to an imported animal. Strong exception must be taken to certain statements, even if they be quotations, connected with fossil Equidæ. It may or may not, for instance, be admitted that the horses of Asia and Europe have an American ancestry; but to state (p. 10) that *Equus stenonis*, the earliest European fossil horse, was one of the earlier immigrants, and that while this species "was extending its range into Europe and Africa, two others, *E. sivalensis* and *E. namadicus*, were finding their way into India," is neither more nor less than nonsense, more especially since the Indian *E. sivalensis* is at least as old, if not older than any known American true horse!

It is time, however, to take into consideration the author's views as to the chief existing types of horses, which appear to be as follows:—First of all we have the "typical horse," that is to say, *Equus caballus typicus*, which we presume must be taken to be the ordinary Scandinavian pony (Fig. 1), although the author does not commit himself upon this point; secondly, the Celtic pony (*E. c. celticus*) of Iceland, the Hebrides, and other parts of north-western Europe; thirdly, the tarpan and Mongolian wild pony, which we may agree to call provisionally *E. c. przewalskii*; and fourthly, the Barb, Arab, and thoroughbred stock, for which the author proposes the name *E. c. libycus*. All the first three appear to be closely allied, and are typically small animals with large heads, short manes, and tails often imperfectly haired at the base, while their general colour is dun with black points. In temper they appear to be intractable, and when first domesticated they seem to have been broken to harness instead of for riding, and to have been controlled with the bit. The Norwegian pony is believed to have considerable intermixture of

[1] "The Origin and Influence of the Thoroughbred Horse." By W. Ridgeway. Cambridge Biological Series. Pp. xvi+535; illustrated. (Cambridge: The University Press, 1905.) Price 12s. 6d. net.

southern blood, and if we allow for this it may be asked whether there is sufficient justification for separating the "Celtic pony" as a distinct race, and whether both do not consequently come under the designation of *E. caballus typicus.* If he be right in identifying the original unaltered tarpan with the Mongolian wild pony (*przewalskii*), the author has done good service, as he certainly has in pointing out that the mouse-colour of the tarpan in the Moscow Museum is a sign of hybridism. Whether *przewalskii* might not also be included under the name of *E. c. typicus* is another question that may be left open.

Turning to the author's fourth type—the Barb, Arab, and thoroughbred—we find this standing out in marked contrast to all the above, so that in any case we have two main groups of domesticated horses. The Barb type, as it may be called for brevity, is a larger horse than the dun northern type, with a more delicate, although long, head, prominent nostrils, curiously sinuous profile, full and profuse mane and tail, a colour which appears to be typically bay, relieved frequently by a white star on the forehead and one or more white "stockings." The occurrence of a depression in front of the eye-socket (whether a remnant of the ancestral face-gland, or, as some suppose, a point for muscular attachment is immaterial) in the skull is admitted as a characteristic of this type. From their large size these horses were from the first used for riding, while their gentle disposition led to their being dominated by a nose-band instead of a bit. All the dark-coloured horses of Europe, notably the Shire horse, are believed to have a more or less strong infusion of Barb or Arab blood, which is, however, most predominant in the thoroughbred.

In thus dividing domesticated horses into two main types, the northern dun and the larger southern bay, Prof. Ridgeway will, we think, command the consent of most naturalists. Whether, however, he is right in regarding the full mane and tail of the Barb type as an original feature and not one largely due to domestication may be an open question. Doubt may be also legitimately entertained as to whether he is justified in making North Africa the birthplace of the bay type. In the first place, there arises a suspicion that he has been biased by a former theory (now happily abandoned) that the Barb type is the descendant of the Somali zebra (*Equus grevyi*). Putting, however, this aside, it may be pointed out that the author does not appear to give sufficient weight to the fact that true wild horses are utterly unknown in Ethiopian Africa, and that northern Africa is but a small outlying part of the Holarctic region, the fauna of which is to a great extent identical with that of southern Europe and western Asia. On these grounds, although we may admit that the true Barb was the earliest representative of the bay type to be domesticated, it seems extremely improbable that the ancestral, and now extinct, form of this race was confined to North Africa, while it is much more likely that it ranged over a large extent of south-western Asia in prehistoric times.

To follow the author in his extremely interesting survey of the spread and modification of the domesticated horse during historic times is unfortunately quite impossible within the limits of our available space, and we can only say that it will repay careful reading. The early existence of the Barb type is indicated by a figure of a Libyan woman riding one of these horses, taken from a vase dating between 664 B.C. and 570 B.C.

In conclusion, the present reviewer, who has been so largely quoted (and by no means in an altogether friendly spirit) throughout the work, may perhaps be permitted a few lines in which to explain his own views on certain points. In the first place, he is affirmed to have definitely assigned India as the birthplace of the bay or Barb type; but reference to the original article (*Knowledge and Scientific News*, August, 1904, p. 174) will show that he merely suggested the derivation of the "thoroughbred and eastern breeds generally . . . from an extinct Indian species, *E. sivalensis.*" It is true that the expression "eastern breeds generally" is somewhat too extensive, but it was meant to apply primarily to Turks and Arabs; while as to *E. sivalensis*, the writer would be the last to suggest that its range was limited to India, and that it might not have had a wide distribution in Asia. In assigning the origin of the Barb type to this or an allied fossil species rather than to the European *E. stenonis*, which likewise presents a pre-orbital depression in the skull, the reviewer was influenced by the fact that the latter is definitely known to have been succeeded in the prehistoric and Pleistocene deposits of north-west Europe by horses which lack that feature. Moreover, if, as Prof. Ridgeway urges, the northern dun and the southern and eastern bay types are essentially distinct, what is more likely than that they should have been respectively derived from Pliocene types of which one is northern and the other eastern and possibly southern? As regards the main thesis—the existence of the two aforesaid main distinct types of domesticated horses—the reviewer is in perfect accord with the author of the work before him. R. L.

SIR J. S. BURDON-SANDERSON, BART., F.R.S.

On Thursday, November 23, in his seventy-seventh year, this distinguished man passed quietly to his rest after a protracted illness of some months. His death removes from the University of Oxford one of its greatest personalities, whilst biological science, especially those branches immediately associated with medicine—physiology and pathology—has suffered an irreparable loss. The remarkable tribute contained in the *British Medical Journal* issued on December 2 shows the extent to which those who are now working at these subjects honoured and reverenced him as their master.

He was born at Jesmond, Northumberland, in December, 1828, being connected on both his father's and his mother's side with men of great distinction; the details of his ancestry are cited in Mr. Francis Galton's hereditary notes as one instance of those family histories which show extraordinary mental capacity or remarkable achievement distributed along the ancestral line. He was never at a public school, but was educated at home in that border county which he always loved, and throughout his life he manifested a special delight in sunlight, stretches of wild moor, mountain streams, rocks, heather, wild flowers, and wild birds. His powers of observation and the interest with which he regarded all natural objects were such that he might have become a great naturalist, but his bent was evidently towards medicine, and his parents, relinquishing their own bias for the legal profession, sent him to Edinburgh for a course of medical training. Goodsir and Hughes Bennett were then the professors of anatomy and physiology, and the latter seems to have exercised great influence on the future physiologist, turning his thoughts to cells and their living processes.

He soon showed some of those characteristics which stamp indelibly the scientific work of his life. Thus,

an entry in the minutes of the students' scientific meetings (Royal Medical Society) of 1850 states that a dissertation was read by John Scott Sanderson, of Newcastle, on vegetable irritability, and his first publication in the *Edinburgh Monthly Journal of Medicine,* 1851, was a criticism of the views held at the time as to the metamorphosis of the coloured blood corpuscles, founded on numerous experiments and observations made by himself. After his graduation in medicine he left Edinburgh and went in 1851 to Paris in order to study chemical methods under Wurtz. Associated with him were several Edinburgh student friends, including Marcet and Pavy; he was soon attracted by the fame of Claude Bernard, whose demonstrations he attended, and by whom he was introduced to Magendie. On his return to England in 1853 Burdon-Sanderson married Miss Herschell (whose brother subsequently became Lord Chancellor), and set up in London as a practising physician, being also attached to St. Mary's Hospital as medical registrar. His wide knowledge and great capacity were immediately recognised, and he was made lecturer in botany and afterwards in medical jurisprudence at the medical school of this hospital.

An opportunity for the display of his powers on a larger scale came in 1856, when he was appointed Medical Officer of Health for Paddington. This office he retained for eleven years, during the last seven of which he held, in addition, the responsible position of Inspector in the Medical Department of the Privy Council, where he became closely associated with one who became his great friend, the late Sir John Simon.

From 1870 his work became more and more identified with experimental investigation along physiological lines, his aim being the more exact study of the reactions of the body tissues in health and in disease. Pathological inquiries were, in his judgment, to be conducted in the spirit, and by the experimental methods, which obtained abroad in connection with physiology, and which he had followed for two years under Claude Bernard. It is the practical application of this physiological view which gives his pathological work such transcendent importance, for in the 'seventies he was the only English pathologist who dealt with the subject in a way which is in accordance with modern methods. A most important outcome of this endeavour to investigate disease by the use of experimental and strictly scientific methods was the bringing over of Dr. Klein to this country.

As assistant professor to Dr. Sharpey in University College, London, from 1870 to 1874, and still more as full Jodrell professor of physiology from 1874 to 1882, he exercised a profound influence upon the advance of medical science. One important aspect of this influence is the revolution which has been effected in the methods of teaching physiology; this was inaugurated by his organisation of class work for practical physiological chemistry and for carrying out simple experiments upon excitable tissues, muscle, nerve, &c. Such practical work, now a conspicuous feature of all academic physiological teaching, was initiated by Burdon-Sanderson, who insisted on its importance, not merely for its obvious educational utility in implanting a knowledge of fact and method, but still more for its value as a means of cultivating powers of observation and inference.

In 1882 he acceded to an urgent request that he should come to Oxford as the first Waynflete professor of physiology. He decided on this course because he believed that it was for the highest interests of medical education, the medical profession, and the public, that the University of Oxford should regain the great position which she once held in regard to medicine. As professor of physiology for twelve years, and then as Regius professor of medicine for nine years, he laboured consistently for this end, and, as his life drew to its close, he had the supreme satisfaction of realising that the end had been practically attained. Departments of human anatomy, physiology, and pathology, efficiently equipped and under competent professors, form the material witness of this achievement, but the students who have passed through the scientific medical course at Oxford furnish still more cogent evidence of the great resuscitation which he has brought about; for Oxford this is his enduring monument.

Sir John Burdon-Sanderson was so distinguished as a scientific man, and conducted important investigations in so many branches of medical science, that it is possible in the space of this memoir to make only a brief reference to the most conspicuous of his researches. As regards the whole of his physiological and pathological work, extending over a period of nearly fifty years, certain features stand out prominently. His adoption throughout of experiment as the only fruitful method; his belief that "no real advance could be made until it became possible to investigate the phenomena by methods approaching more or less closely to those of the physicist in exactitude"; his constant anxiety that attention should be focused upon the processes which are observed in living tissues, whether normally present in health or modified in disease; and finally his conviction that all such processes, observed either in isolated tissues or in particular organs of the body, are to be regarded as exhibited because they are inexorably linked with the interests of the whole organism of which the particular structures form a part—natural selection in its widest sense.

In practical medicine his desire for exactitude led him to invent the stethograph for obtaining mensurable records of the respiratory movements of man, and to modify Marey's sphygmograph in order to obtain such records of the arterial blood pressure.

In pathology he employed similar exact methods for the investigation of the inflammatory process and of infective diseases, particularly tuberculosis, pyæmia, and septicæmia. His reports to the Privy Council, and his other publications on these subjects, reveal conceptions as to the character of the processes involved in disease, and of the nature of the response of the normal tissues to infective introduction, which are still far ahead of the general knowledge of the present day, and are viewed from the standpoint, in all essentials, of the modern pathologist. A remarkable instance of this is furnished by his early work on immunity, a subject which, in its recent development, has acquired an importance for the health of the community which it would be difficult to overestimate. Thus, three years before Pasteur published his celebrated work on the subject, Burdon-Sanderson showed that anthrax virus could be attenuated by its transmission through the bodies of rodents, and suggested that it might be possible, by using the attenuated virus, to confer protection against the disease.

In physiology he carried out from 1871 to 1878 experimental inquiries upon the mechanism of circulation and of respiration, made an extensive investigation as to asphyxia, and was the first to show that the nerve fibres in the corona radiata of the cerebral hemispheres would, when locally excited, give rise to definite body movements. But his main work dealt

with the fundamental characters of those elementary processes which are displayed by the excitable tissues of both animals and plants when their activities are aroused by definite stimulation; he thus returned to the topic which had attracted him during his student life at Edinburgh. The published researches of his later years on this subject have become models for all subsequent work, commanding admiration on account of the completeness of their design, and carrying conviction through the security of their foundation, which rests on the solid ground of mensurable records. The electromotive phenomena displayed by active tissues appeared to him to furnish the most trustworthy of such records, provided that appropriate instrumental methods were employed in their investigation; these he made every effort to utilise, and for this end he introduced into physiological method the recording capillary electrometer. His publications on the electromotive phenomena of the beating heart, on similar phenomena in the excitable leaves of the Dionæa plant, in voluntary muscle, in the electrical organs of fishes, &c., are examples of his activity in this field.

In the last year of his life he was still engaged upon this engrossing subject, and was planning and supervising investigations for the further elucidation of the electromotive phenomena present in muscle when thrown reflexly into activity. This piece of work, and others on various subjects of like nature, remain in an unfinished state, but, though fragmentary, they are so suggestive that it may be hoped they will be included in a future collection of his numerous scientific papers.

In conclusion, reference must be made to that commanding influence which true greatness exerts over other scientific workers, moulding their thought, stimulating their powers, and enriching their lives. The factors which contribute to the wielding of this influence defy precise definition, since, apart from acknowledged achievement in science, their essence is to be sought for in certain mental, moral, and physical qualities. In Burdon-Sanderson's case conspicuous traits stamped him as a leader of men, for his inspiring personality, his extraordinary charm of manner, and his wonderfully expressive face made a profound impression even on those whom he casually met. But his students, using the term in its largest sense, were conscious that the real impression made upon them was the work of more potent factors; his courtesy to even the humblest worker, the sympathetic interest with which he followed all experimental work, the breadth of his view, the profundity of his knowledge, ever placed ungrudgingly at the disposal of everyone who sought his help, the genuine character of his devotion to scientific truth, and the unwavering firmness with which he advocated the use of experimental methods. All these combined to attract and hold the younger physiologists and pathologists, and since they realised that it was a delight to him to mix with younger men the influence he exerted was profound. He often expressed his intense satisfaction at the vast change of which he had been a witness, a change which has in thirty years advanced British physiology and pathology into the first rank. The name of Burdon-Sanderson will be permanently associated with this extraordinary advance, for it is generally recognised that by work, example, and precept he has contributed in a very special degree towards the creation in this country of that vigorous band of workers who have given English medical science such a wide reputation.

F. G.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Thursday, November 30, when the report of the council was presented, the president delivered his address, and the new council already announced (p. 33), for the year 1906, was elected. In the evening the anniversary dinner was held at the Hotel Metropole, Lord Rayleigh, the newly-elected president, being in the chair.

The report of the council refers, among other subjects, to the Royal Society Catalogue of Scientific Papers, the International Catalogue of Scientific Literature, the Meteorological Office, tropical diseases, Antarctic work, seismology, the International Geodetic Association, Indian Trigonometrical Survey, Astrographic Chart, and the National Physical Laboratory. A few matters recorded in the report have not been announced or described in these columns, and may therefore be mentioned here.

At the beginning of August, the Treasury expressed willingness to place on the estimates a sum not exceeding 200*l.* as an annual national contribution toward the expenses of the central bureau of the International Seismic Organisation should the adhesion of Great Britain to the international scheme be agreed to. On November 2, the council, having received a report on the subject from the Society's seismological committee, agreed to recommend that H.M. Government should join the organisation, and advised that Prof. Schuster be appointed the representative of this country to the organisation. The Treasury has agreed to the continuation by Great Britain of its adherence to the Geodetic Convention of 1895 for a further period of ten years from January 1, 1907, and to a payment during that period of an annual subscription of 6000 marks. Also, at the instance of the Royal Society, the Treasury has undertaken that one-half the cost of printing the British section of the International Astrographic Catalogue executed under Prof. Turner's direction, within a limit of 1000*l.*, shall be met from public funds.

The report of the council concludes with an expression of appreciation of Sir William Huggins's services to the Society during the five years in which he held the office of president, and the announcement that Lord Rayleigh had accepted nomination as his successor.

In his presidential address, Sir William Huggins dwelt upon the influence which discoveries of science have had upon the general life and thought of the world, especially during the past fifty years, and the place that science should take in general education. Some extracts from the address are subjoined:—

The influence of science during the last fifty years has been in the direction of bringing out and developing the powers and freedom of the individual, under the stimulation of great ideas. To become all that we can become as individuals is our most glorious birthright, and only as we realise it do we become, at the same time, of great price to the community. From individual minds are born all great discoveries and revolutions of thought. New ideas may be in the air and more or less present in many minds, but it is always an individual who at the last takes the creative step and enriches mankind with the living germ-thought of a new era of opinion.

All influences, therefore, and especially all laws and institutions which tend to lose the individual in the crowd, and bring down the exceptional to the level of the average, are contrary to the irresistible order of nature, and can lead only to disaster in the individual and in the State.

I should not omit to mention the marvellous secondary effects of scientific discoveries upon the mental progress of

the civilised world which are being wrought by their practical applications to the cheapening of paper, and to improvements of the automatic printing-press, which, combined with the linking together of all parts of the earth by a network of telegraphic communications, put it in the power of even the poor of the realm to read daily the news of the world, and for a few shillings to provide themselves with a library of classical works. Of scarcely less educational influence upon the public mind are the new methods of photography and mechanical reproduction, by which pictures of current events and the portraits of those who are making contemporary history, and also copies of the world's masterpieces of painting and of sculpture, are widely disseminated with the cheap newspapers and magazines among the mass of the people.

Golden will be the days when, through a reform of our higher education, every man going up to the universities will have been from his earliest years under the stimulating power of a personal training in practical elementary science; all his natural powers being brought to a state of high efficiency, and his mind actively proving all things under the vivifying influence of freedom of opinion. Throughout life he will be on the best terms with nature, living a longer and a fuller life under her protecting care, and through the further disclosures of herself, rising successively to higher levels of being and of knowledge.

The importance to every man of a practical acquaintance with elementary science is obvious. Would it be thought possible that any nation could act so absurdly as to teach its children other languages, and leave them in complete ignorance of the tongue of the land in which they would have to pass their lives? Would it not then be incredible, if it had not become a too familiar fact, that the public schools have, until recently, excluded all teaching of the science of nature from their scheme of studies, though man's relation to nature is more intimate than to his fellow countryman? We live, move, and have our being in nature; we cannot emigrate from it, for we are part of it. Yet our higher education leaves men, who in other directions are well informed, much as deaf-mutes in the presence of nature. They do not hear her most imperative warnings, and can only get on haltingly in their everyday intercourse with the natural forces to which their lives are subjected, by means of the arbitrary signs of empirical custom. The recent introduction of some amount of science-teaching in our higher schools is quite inadequate, alike in kind and in degree. It can be only through a reform of the scheme of their examinations by the universities that we can hope to see science take the equal part with the humanities in general education to which she is entitled.

Two faculties of the mind which it is of the highest importance, especially in early youth, to enlarge and develop by exercise are wonder and imagination. Under the ordinary premature language-teaching of the grammar schools, even the wonder and imagination natural to young minds become so stunted in their growth as to remain more or less dormant throughout life. On the other hand, natural science brings them into full activity and greatly stimulates their development. Nature's fairy tales, as read through the microscope, the telescope, and the spectroscope, or spelt out to us from the blue by waves of ether, are among the most powerful of the exciting causes of wonder in its noblest form; when free from terror it becomes the minister of delight and of mental stimulation.

And surely the master-creations of poetry, music, sculpture, and painting, alike in mystery and grandeur cannot surpass the natural epics and scenes of the heavens above and of the earth beneath, in their power of firing the imagination, which, indeed, has taken its most daring and enduring flights under the earlier and simpler conditions of human life when men lived in closer contact with nature and in greater quiet, free from the deadening rush of modern society. Of supreme value is the exercise of the imagination, that lofty faculty of creating and weaving imagery in the mind, and of giving subjective reality to its own creations, which is the source of the initial impulses to human progress and development, of all inspiration in the arts, and of discovery in science.

Further, elementary science, taught practically with the aid of experiment during a boy's early years, cannot fail to develop the faculty of observation. However keen in vision, the eyes see little without training in observation by the subtle exercise of the mind behind them. From the humblest weed to the stars in their courses, all nature is a great object-lesson for the acquirement of the power of rapid and accurate noting of minute and quickly-changing aspects. Such an early training in the simpler methods of scientific observation confers upon a man for life the possession of an inexhaustible source of interest and delight, and no mean advantage in the keen competitions of the intellectual activities of the present day.

Training in the use of the eyes develops, at the same time, alertness of the intelligence, and suppleness of the mind in dealing with new problems, which, in after life, will be of great value in facing unforeseen difficulties of all kinds, which are constantly arising.

Science, practically taught, does more, for, under the constant control of his inferential conclusions by the unbending facts of direct experiment, the pupil gradually acquires the habit of reasoning correctly from the observations he makes. In particular, he learns the most precious lesson of great caution in forming his opinions, for he finds how often reasoning, which appeared to him to be flawless, was not really so, for it led him to wrong conclusions. Further, from the constant study of nature, the student comes so to look at things as almost unconsciously to discriminate between those which are essential and those which are only accidental, and so, gradually, to acquire the faculty of classing the facts of experience, and of putting them in their proper places in a consistent system or theory. Are there any other studies, it may be asked, by which, in the same time, a young mind could develop an equally enlarged capacity for correct reasoning and acquire so wide an outlook? Yet, notwithstanding the immense intrinsic value of its teaching, science is but one of the studies which are necessary for a wide and liberal education. Intellectual culture, or, in other words, the whole mind working at its best, requires, besides the training of all its powers harmoniously by the study of nature, an acquaintance with many other kinds of knowledge, especially of human history and the development of human thought, and of the human arts. Humanistic studies and experimental science are equally essential, and, indeed, complement each other. Either alone leaves the mind unequally developed, and its whole attitude one-sided, and so produces a narrow type of mind, which is incapable of taking a wide view even of its own side of thought, and has but little sympathy with any subject outside it.

Improved methods of teaching the classical languages, which would permit of the beginning of the study of them at a later age, would leave ample time for an early training in experimental science, which must soon come to be recognised as an essential part of all education.

In future, no grammar or higher school should be considered as properly provided for unless furnished with the necessary apparatus for teaching experimentally the fundamental principles of mechanics, physics, and biology. The pupils should have the use of a small astronomical telescope, and of microscopes for biological work. Such apparatus and instruments can now be purchased at a very small cost.

Clearly, it is only by such a widening of the general education common to all who go up to the universities, before specialisation is allowed, that the present "gap between scientific students careless of literary form, and classical students ignorant of scientific method" can be filled up, and the young men who will in the future take an active part in public affairs, as statesmen and leaders of thought, can be suitably prepared to introduce and encourage in the country that fuller knowledge and appreciation of science which are needed for the complete change of the national attitude on all science questions, which is absolutely necessary if we are to maintain our high position and fulfil our destiny as a great nation.

This address was followed by the award of the medals.

Copley Medal.

The Copley medal is awarded to Prof. Dmitri Ivanovitch Mendeléeff, For.Mem.R.S., for his contributions to chemical and physical science.

Prof. Mendeléeff, born at Tobolsk, in Siberia, in 1834,

stands high among the great philosophical chemists of the last century. As early as 1856 he published his own conclusion that paramagnetic elements have, in general, smaller molecular volumes than diamagnetic elements, and confirmed Avogadro's view that electropositive elements have larger molecular volumes than electronegative ones, both of them results specially interesting in connection with modern views of molecular structure. At that time he had already assimilated and utilised the views of Laurent, Gerhardt, and Williamson on molecular constitution, which made such slow progress in general. Since then, in the words of Dr. Thorpe (NATURE, June 27, 1889), "There is, in fact, no section of chemical science which he has not enriched by his contributions"—mineralogy, chemical geology, organic chemistry, the nature and industrial importance of petroleum, but, above all, physical chemistry and chemical philosophy.

Quoting again from Dr. Thorpe:—"His 'Principles of Chemistry,' published in 1889, and repeatedly reprinted, is a veritable treasure-house of ideas, from which investigators have constantly borrowed suggestions for new lines of research. This book is one of the classics of chemistry; its place in the history of science is as well assured as the ever-memorable work of Dalton." In the course of its preparation he developed the great generalisation known as the periodic law of the elements, with which his name will ever remain most closely associated, especially as a weapon for predicting new elements, and for which he has received the Davy medal of this society, as also have Newlands and Lothar Meyer for their independent advances in the same direction.

This law has changed the face of chemistry by imparting to the study of its numerous independent elements that close inter-connection which is a characteristic of advanced physical theories.

Royal Medals.

A Royal medal is awarded to Prof. John Henry Poynting, F.R.S., on account of his researches in physical science, especially in connection with the law of gravitation and the theories of electrodynamics and radiation.

Prof. Poynting is distinguished both in theoretical and experimental physics. His memoir, *Phil. Trans.*, 1884, "On the Transfer of Energy in the Electromagnetic Field," contains the fundamental proposition which is now universally known as Poynting's theorem. It was followed in *Phil. Trans.*, 1885, by a paper "On the Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field," which works out the current circuit on the supposition of motion of what are now called Faraday tubes. These papers served greatly to elucidate Maxwell's theory, and give a representation of the physical nature of the electric field which is now widely utilised. His long-continued experimental and theoretical researches on the constant of gravitation and on the mean density of the earth are reported in a paper in the *Phil. Trans.*, 1892, and in the Adams prize essay for 1893. Closely related to this subject is an experiment in search of a directive action of one quartz crystal on another, *Phil. Trans.*, 1899, which, though leading to a negative result, is a model of the application of refined methods to a physical research of great delicacy. His recent paper, *Phil. Trans.*, 1903, "On Radiation in the Solar System, its Effect on Temperature, and its Pressure on Small Bodies," is of great interest and significance in cosmical physics. He is the author of various theoretical papers on physicochemical subjects, such as change of state and osmotic pressure, which are conspicuous for originality of conception and clearness of exposition.

The other Royal medal is awarded to Prof. Charles Scott Sherrington, F.R.S., for his work on the central nervous system, especially in relation to reflex action.

Prof. Sherrington has published a series of important papers upon the structure and function of the brain and spinal cord. In the earlier of these he chiefly investigated the course of the several groups of nerve fibres by means of the degeneration method. Passing from the study of structure to that of function, he discovered that removal of the fore brain causes a widespread rigidity of certain muscles, which he called decerebrate rigidity. In the state of decerebrate rigidity, the ordinarily observed reflexes of the body become profoundly altered, and a study of the normal and abnormal reflexes led him to the observation that contraction of one muscle is commonly associated with inhibition of its antagonist. Upon this he formulated the law of the reciprocal action of antagonistic muscles, which is now accepted as of fundamental importance in the coordination of muscular movement. A further study of reflex actions led him to lay down certain general principles with regard to them. One principle deserves especial mention, namely, that hurtful stimuli applied to the skin produce a different form of reflex from that given by stimuli which are not hurtful. This has served as a basis for further investigation on the character of the nerve impulses conveyed by different nerve-endings, on the course taken by the impulses, and on their central connections.

In recent years a considerable amount of work has been done in mapping out the areas of the skin supplied by each of the cranial and spinal nerves. This work, essential both to physiology and to clinical medicine, received its chief impetus and most weighty contribution from the careful and detailed observations of Prof. Sherrington.

The researches of Prof. Sherrington and Dr. Grünbaum, on the localisation of the excitable areas in the cortex of the cerebral hemispheres in the higher apes, have resulted in placing the "motor area" in this animal entirely in front of the central sulcus. The result is now generally accepted as true also for the brain of man—a point of great importance in the surgery of the brain.

Prof. Sherrington's researches have dealt with a number of subjects cognate with that of the central nervous system. He has shed light on questions connected with the afferent nerves of skeletal muscle, the efferent nerves of the arrectores pilorum and of the cranial blood-vessels, the innervation of various viscera, the trophic centre of the fibres of the roots of the spinal nerves, the knee jerk, and with the physiology of vision.

Davy Medal.

The Davy medal is awarded to Prof. Albert Ladenburg, on account of his researches in organic chemistry, especially in connection with the synthesis of natural alkaloids.

Thirty years ago, when the validity of Kekulé's famous formula for benzene was the subject of much discussion, Ladenburg was the first to prove, by laborious research, the important proposition that the six hydrogen atoms in the hydrocarbon are similarly situated and discharge the same functions, and hence that three, and only three, *di*-substitution derivatives can exist.

He has also devoted many years to the study of the natural alkaloids. This pioneer work, attended by many experimental difficulties, was rewarded by success in the synthesis, for the first time in 1886, of an optically active compound identical with the alkaloid coniine existing in the hemlock plant. Since that time he has largely added to our knowledge of the chemistry of hyoscyamine, atropine, and other alkaloids of the mydriatic class.

Hughes Medal.

The Hughes medal is awarded to Prof. Augusto Righi, for his experimental researches in electrical science, including electric vibrations.

Prof. Righi has been for many years a prominent and active worker in the sciences of light, electricity, and magnetism.

Among the subjects which have engaged his attention are the Hall effect, and the change of electric conductivity of bismuth in a magnetic field. At an early period he carried out an elaborate investigation on the reflection of light at the surface of a magnetised body, repeating and extending Kerr's observations with more powerful apparatus; in particular, he showed how the amount of the rotation of the plane of polarisation depends upon the wave-length of the light.

A valuable series of papers related to phenomena produced by the ultra-violet rays, including the first discovery of the discharge of negative electricity from a freshly polished zinc surface under their influence. He has also investigated the potential in the neighbourhood of the kathode in a Crookes's tube, and made many experiments on the spark discharge in gases and the action of the Röntgen rays.

His work on electric radiation has been collected in a book, "L'Ottica delle oscillazioni elettriche," Bologna, 1897. He rendered fundamental service to exact experiment on this subject by simplifying the practical conditions of the problem; and he applied his improved apparatus to numerous investigations on the behaviour of electromagnetic waves, of short and therefore manageable wave-length, under very varied conditions, on their absorption, polarisation, reflection and refraction, and on the behaviour of dielectrics in the field of radiation. This work entitles him to a high place among those who developed the lines of experimental investigation opened up by the great discoveries of Hertz.

More recently he has contributed substantially to the study of the phenomena of radio-activity and the related ionisations.

THE DEATH-KNELL OF THE ATOM.[1]

Old Time is a-flying; the atoms are dying;
Come, list to their parting oration:—
"We'll soon disappear to a heavenly sphere
On account of our disintegration.

"Our action's spontaneous in atoms uranious
Or radious, actinious or thorious:
But for others, the gleam of a heaven-sent beam
Must encourage their efforts laborious.

"For many a day we've been slipping away
While the savants still dozed in their slumbers;
Till at last came a man with gold-leaf and tin can
And detected our infinite numbers."

Thus the atoms in turn, we now clearly discern,
Fly to bits with the utmost facility;
They wend on their way, and in splitting, display
An absolute lack of stability.

'Tis clear they should halt on the grave of old Dalton
On their path to celestial spheres;
And a few thousand million—let's say a quadrillion—
Should bedew it with reverent tears.

There's nothing facetious in the way that Lucretius
Imagined the Chaos to quiver;
And electrons to blunder, together, asunder,
In building up atoms for ever!

W. R.

[1] Sung at the Chemical Laboratory dinner at University College, November 17.

NOTES.

THE Hayden memorial gold medal has been awarded by the Academy of Natural Sciences of Philadelphia to Mr. C. D. Walcott, director of the U.S. Geological Survey, in recognition of the value of his individual contributions to geological science.

THE University of Basle, to which the late Prof. Dr. Georg W. A. Kahlbaum was attached for nearly twenty years, has received the sum of 100,000 francs from the mother of the deceased professor. Further, Prof. Kahlbaum's scientific library and physical instruments are also to be handed to the university.

FROM Berlin we learn, according to the *Chemiker-Zeitung*, that the German State grant for the support of scientific, technical, and similar undertakings is to be increased by 115,000 marks. The sum of 179,500 marks is to be spent upon increasing the accommodation for the permanent exhibition devoted to the interests of the working classes; 120,000 marks to be a first instalment for an investigation of sleeping sickness; 30,000 marks to be devoted to the development of the *Starkstrom*-laboratory of the Reichsanstalt; 43,850 marks to be contributed to the kite station on Lake Constance for experimental investigations of the higher air strata.

THE annual conference of the Pharmaceutical Society will be held in Birmingham in the week beginning July 23, 1906.

FOR the erection of a monument to Franz Reuleaux in the Charlottenburg Technical School, an appeal for subscriptions has been issued by the engineering department of the school.

MR. F. W. DYSON, F.R.S., chief assistant, Royal Observatory, Greenwich, has been appointed Astronomer Royal for Scotland, and also professor of practical astronomy, Edinburgh University, in succession to the late Dr. Copeland.

AN exhibition of electrical, optical, and other physical apparatus has been arranged by the Physical Society, and will be held on Friday evening, December 15, at the Royal College of Science, South Kensington. Admission will be by ticket only.

IT is reported, *Science* says, that the Mexican Astronomical Society has awarded the prize offered by the Bishop of Leon for some notable astronomical discovery to Prof. W. H. Pickering, of Harvard College Observatory, for the discovery of the tenth satellite of Saturn.

AN archæological museum, which will devote special attention to Indo-Chinese matters, has been established by the French Government at Pnompenh. The museum will be under the scientific control of the École française d'Extrême-Orient, the chief of the archæological department of which school will act as director of the new museum.

A DESCRIPTION is given in the *Engineer* of December 1 of some interesting machine-tools, formerly the property of James Nasmyth, lately placed on view in the southern galleries of the Victoria and Albert Museum. Although associated primarily with the invention of the steam-hammer, James Nasmyth did valuable work in the improvement of machine-tools.

AN extensive landslip has occurred in the Danish island of Möen, destroying part of the beautiful scenery along Lille Klint. From the beach, steep slopes of Boulder-clay, thickly wooded, rise about 250 feet. The right bank of the valley from Liselund Chateau, and the coast-cliff for some 400 yards to the south of it, in all some fifteen or twenty acres of woodland, are described as having sunk bodily. The sea had been encroaching, but underground water is regarded as the cause.

A *Times* correspondent reports that a local Greek newspaper publishes details of the earthquake of November 8, which caused great damage to the various monasteries on Mount Athos. The shocks, which were extremely violent, occurred in the night. None of the monasteries escaped without serious injury. The shocks were not confined to the colony of monks. At Caryes the post-office, the police station, and other public buildings have been ruined, and at Cassandra, Jerissos, Gomate, and other villages within the districts affected the churches and many houses have been destroyed.

IN the course of a lecture delivered at the Armstrong College, Newcastle-on-Tyne, on December 2, the Hon. C. A. Parsons, F.R.S., dealt with the application of turbines to Atlantic passenger steamers, and described the

recent trials of the Cunarder *Carmania* with turbine engines, and her sister ship, *Caronia*, with reciprocating engines, the latter being one of the most economical vessels ever built. The *Carmania* beat the *Caronia* by one knot, and was at least 16 per cent. more economical than her sister vessel driven by reciprocating engines. The *Carmania* is the first example on so large a scale, and it may be reasonably expected that improvements in detail will increase still further the excellent results she realised.

MAJOR MOODIE, Governor of Hudson Bay, has received a communication, dated May 22 last, from Captain R. Amundsen's Norwegian Expedition to the North Pole. The *Gjoa*, with the expedition on board, spent last winter in Simpson Strait, King William's Land, 400 miles north of Fullerton. Captain Amundsen dispatched letters from Fullerton in November, 1904, reporting the expedition well, but short of dogs. The messenger reached Governor Moodie's headquarters on March 18 of this year, and on March 26 he started back with ten dogs. The messenger reached Captain Amundsen's party on May 22, and then returned to Fullerton with a second letter. This reported that the observations of the party had been conducted undisturbed since the establishment of the magnetic station in October, 1903.

AT a meeting of the council of the Invalid Children's Aid Association, held last week, Sir William Broadbent delivered an address on the tuberculous children of the metropolis, in which he pointed out that while consumption, the most prevalent form of tuberculous disease, has steadily diminished year by year for the last thirty years, there has been no corresponding diminution in the death-rate of tuberculous affections specially incident to infancy and early childhood. He strongly urged the establishment of country and sea-side homes where delicate children in the pre-tuberculous stage, or those actually suffering from tuberculosis, could receive the benefits of the open-air treatment. After alluding to the sanitary defects of tenements in which the poor too often have to live, he pointed out that the greatest safeguard against tuberculosis in early life, and against infantile mortality generally, is that the child should be suckled by the mother.

THE council of the Iron and Steel Institute has arranged that the annual general meeting of the institute shall be held in London on May 10–11, 1906. In place of the usual autumn meeting, a joint meeting with the American Institute of Mining Engineers will be held in London on July 23–28. It is intended during the week following to give the American visitors an opportunity of seeing some of the iron-making districts. It is anticipated that the visiting party will include many of the leading ironmasters who entertained the Iron and Steel Institute in America in 1890 and 1904. The Lord Mayor of London has consented to act as chairman of the London reception committee, and to give an evening reception at the Mansion House.

LECTURES on agricultural subjects are given in connection with the County Technical Laboratories, Chelmsford, on Friday afternoons, which is the market day of the town. The lectures last about half an hour, and are intended for farmers and others interested in agriculture. A discussion follows the lecture. The subjects for the December meetings, with the lecturers dealing with them, are as follows:—The field culture of the potato, by Mr. A. Steel; England as a producer of sugar from home-grown sugar beetroot, by Mr. Sigmund Stein; some agricultural facts and figures, by Mr. R. H. Rew. This excellent plan of making it easy for farmers to hear of the results of modern agricultural research deserves to be successful, and could be adopted with advantage in other agricultural centres.

AT a general monthly meeting of the members of the Royal Institution, held on Monday, special thanks were returned to Dr. Ludwig Mond, F.R.S., for his donation of 500*l*. to the fund for the promotion of experimental research at low temperatures. It was announced that the managers had elected Prof. W. Stirling Fullerian professor of physiology. The following are among the lecture arrangements at the Royal Institution before Easter:—A Christmas course of six illustrated lectures, adapted to a juvenile auditory, by Prof. H. H. Turner, on astronomy; Prof. E. H. Parker, three lectures on impressions of travel in China and the Far East; Prof. William Stirling, six lectures on a physiological subject; Dr. J. E. Marr, three lectures on the influence of geology on scenery (the Tyndall lectures); Mr. Benjamin Kidd, two lectures on the significance of the future in the theory of evolution; Mr. Francis Darwin, three lectures on the physiology of plants; Prof. B. Hopkinson, three lectures on internal combustion engines; Mr. J. W. Gordon, two lectures on advances in microscopy; and Prof. J. J. Thomson, six lectures on the corpuscular theory of matter. The Friday evening meetings will commence on January 19, when Prof. J. J. Thomson will deliver a discourse on some applications of the theory of electric discharge to spectroscopy. Succeeding discourses will probably be given by Prof. S. P. Thompson, Mr. H. F. Newall, Mr. W. C. D. Whetham, Dr. R. Caton, Dr. Hutchison, Sir Andrew Noble, Bart., Prof. P. Zeemann, Mr. W. B. Hardy, and others.

THE Russian physiologist, Prof. Iwan Michaelowitsch Ssetschenoff, emeritus professor of the University of Moscow, who died on November 15, was born in 1829. He first attended an engineering school in St. Petersburg, but subsequently took up medicine, and, after passing his final examination in Moscow in 1856, studied for some time in Germany. By his interesting paper on brain reflex he first attracted the serious attention of his colleagues of the Medico-chirurgical Academy in St. Petersburg, in which he was appointed an assistant professor of physiology in 1860, but on account of the strict censure to which his further work was submitted, Ssetschenoff published the results of his scientific investigations in Germany. A pupil of Du Bois-Reymond, Helmholtz, Hoppe-Seyler, and Ludwig, he always remained in direct connection with European scientific circles. The greatest services which Ssetschenoff rendered to science lie in the province of physiological chemistry, as, for instance, his works on the absorption of carbon dioxide by the blood. A complete list of his numerous researches would clearly testify to his many-sidedness and breadth of view. Moreover, he earnestly endeavoured to popularise his special science to the Russian mind by presenting it in an easily intelligible form in such well written and well reviewed works as his "Physiological Studies," "Physiology of the Vegetable Processes," "Psychological Studies," &c. In 1870 Ssetschenoff was appointed professor of physiology in the University of Odessa, and in 1876 to a similar post in St. Petersburg, which he held until 1889. He then went to Moscow, where he first acted as privatdocent and afterwards (1891) as professor, retiring in 1896.

IN the second part of his article on the histology of cartilage and kindred tissues, published in vol. lxxx., part ii., of the *Zeitschrift fur wissenschaftliche Zoologie*, Mr. J. Schaffer discusses these structures in the hag-fish (Myxine), with special reference to the cranial skeleton of that genus, adding an appendix on the cartilage of the

lampreys. The organisation of the "bear-animalcules," or Tardigrada, those microscopic creatures found in damp moss and the gutters of roofs, forms the subject of an article by Mr. A. Basse; while the third and last communication is the first portion of a memoir by Mr. S. Hlava on the Radiata, the author dealing in this instance with the anatomy of *Conochiloides natans*.

IN an important article on the cranial nerve-components of the lamprey (Petromyzon), published in Gegenbaur's *Morphologisches Jahrbuch*, vol. xxxiv., part ii., Mr. J. B. Johnston shows that the general arrangement is similar to what obtains in fishes, although with certain markedly primitive features. As the result of a study of the visual organs of the ascidians of the Salpa group, Mr. W. Redikorzen arrives at the conclusion that the primitive chordates possessed a series of paired organs of this nature extending from the head to the tail—one pair to each body-segment. Moreover, the pineal eye was certainly in the first instance a dual structure, but later its two elements coalesced and subsequently degenerated. This segmental ocular type has entirely disappeared from vertebrates, and is now represented only by traces among the lower groups. The other papers in the same issue include one by Mr. T. Mollison on the dorsal gland of Dendrohyrax, and a second by Mr. J. Bohm on the reproductive organs of the sheep.

IN the November issue of the *Zoologist* Mr. G. Renshaw resumes his interesting series of "obituaries" of exterminated animals, dealing in this instance with the Réunion starling, the sole representative of the genus Fregilupus. Easily recognised by its parti-coloured plumage and long crest, this bird was probably discovered by Flacourt in the middle of the seventeenth century. In the early part of the last century it was abundant, but in 1833 had become extremely scarce, and by about 1860 had probably ceased to exist even in its last refuge in the interior of the island. Twenty-one skins, of which one is in the Natural History Museum (although not shown to the public), and two skeletons, of which one is at Cambridge, are all the relics of this interesting species Mr. Renshaw can identify. In another paper Dr. J. Murie discusses the flying-fish captured in September last in a back-water connected with the Medway estuary. It is believed to belong to *Exocoetus lineatus*, a species not previously recorded as an occasional straggler into British waters.

THE almost complete shell of a large Cretaceous turtle from Kansas has afforded Mr. G. R. Wieland the opportunity of enlarging our knowledge of the extinct genus Toxochelys, his communication on the subject being published in the November issue of the *American Journal of Science*. The structure of the shell agrees with that of certain extinct representatives of the Chelonidæ (Lytoloma), but the skull approximates to that of the Chelydridæ. That the genus should be classed with the true turtles the author is convinced, although he believes the limbs to have been independently modified for swimming. The most interesting part of the paper relates, however, to certain bony elements overlying the junctions between the neural bones of the carapace, and it is suggested that these, which may have been more extended in other types, may represent the mosaic-like shell of the leathery turtles (Dermochelyidæ). If this suggestion be well founded, the puzzle of the origin of the carapace of Dermochelys will be practically solved.

THE *Comptes rendus* of the zoological congress held at Berne last year contains the full report of a series of experiments undertaken by Mr. H. Piéron with the view of ascertaining the seat of the recognition-sense among ants. The theory of a "language-sense" resident in the antennæ is rejected by the author, to some extent on the ground that these organs are employed in feeling objects of every kind, animate and inanimate. On the other hand, it is inferred that these organs are endowed with an olfactory sense, on which depends mutual recognition among ants. As is well known, ants not only of different species, but of different communities of the same species, display marked hostility to one another. By making an infusion of ants of one particular community, and anointing the neuters of another community with this infusion, it was found that in most instances the hostile ants thus treated were not attacked by the members of the community from which the infusion was made, this immunity from attack lasting only so long as the influence of the infusion persisted. On this and other experiments of a kindred nature the author's conclusions are mainly based. But to connect these experiments with the antennæ, an ant was deprived of those appendages, when it was found to attack friends and foes alike. Mr. Piéron has also favoured us with a copy of another paper, from the *Bulletin de l'Institut psychologique* for 1904, on the *rôle* of the muscular sense in determining orientation among ants.

THE experimental station at Peradeniya, Ceylon, has rapidly grown into public favour, and large numbers of agriculturists visit the station to get practical lessons in their craft. From the annual report of the controller, Mr. H. Wright, published as vol. iii., No. 10, of the Circulars of the Royal Botanic Gardens, it will be seen that a considerable amount of time has been devoted to the subject of green manures. While the first object consists in growing a crop to turn into the soil, the additional advantage possessed by leguminous plants of fixing free nitrogen has led to their almost exclusive use. In a tropical country green manures also prevent erosion of the soil by heavy rain and the baking of the surface by the hot sun. *Crotalaria striata* is strongly recommended for tea estates, since it produces a heavy crop. A plant of a different kind is the thornless dadaps, *Erythrina lithosperma*, from which cuttings five feet long planted in the rainy season gave a substantial yield. The Pondicherry variety of groundnut has also proved useful.

IN the report of the director of the Mineralogical Survey contained in the Ceylon Administration Reports much valuable information is given by Mr. A. K. Coomaraswamy and Mr. James Parsons regarding the occurrence of corundum, of minerals containing rare earths, of precious stones, of crystalline limestone, of mica, and of graphite. With the aid of numerous illustrations, interesting descriptions are also given of the native Sinhalese manufacture of iron and steel, and of the washing of gem-bearing gravels. The minerals containing rare earths have been derived from intrusive granite rocks. Thorianite containing more than 70 per cent. of thoria and 12 per cent. to 15 per cent. of uranium oxide occurs in moderate quantities near Kondrugala. The whole amount obtained hitherto is less than 30 cwt., and it is doubtful whether any very extensive deposit occurs. Thorite, allanite, and minerals of the samarskite group have also been found. The gems met with are transparent and well coloured varieties of corundum, spinel, zircon, tourmaline, topaz, garnet, chrysoberyl, cordierite, amethyst, felspar, and beryl. Many of these are exhibited in the mineral gallery of the museum attached to the survey, and the director is making strenuous endeavours to get together a thoroughly representative collection which can always be consulted by visitors to Ceylon.

A useful series of memoirs is being published monthly in the *Bulletin du Musée océanographique de Monaco*. In No. 44, for October, Prof. Hergesell discusses some future problems of maritime meteorology; by this name he refers to the meteorological phenomena of the atmosphere over the oceans. He remarks that if our knowledge is well advanced over the land, it is much less so over the oceans, and that our knowledge over the sea is due to a great extent to such expeditions as those of the *Challenger*, *Gazelle*, and *Valdivia*. Others might have been cited, *e.g.* the Austrian expedition of the *Novara* in 1857–9. But we cannot help remarking that the meteorology over the oceans might be considered as fairly well defined, owing to the labours during the last fifty years of such men as Maury in the United States, FitzRoy and Toynbee in this country, Leverrier and Brault in France, Buys Ballot and Andrau in Holland, Neumayer in Germany, and, of course, including their successors in the central meteorological offices of the respective countries. But while much has been done in the investigation of the upper air over the land by the use of kites and balloons, both manned and unmanned (or "sounding" balloons), and some surprising results have been obtained, little has yet been done in this respect over the oceans. The balloon ascents over the land have shown, for instance, that there is a warm stratum of air at a height of about 11 kilometres; that the decrease of temperature with altitude ceases more or less abruptly, and that the temperature actually increases for a further height of several kilometres. This zone of inversion is probably intimately connected with the general circulation of the atmosphere, and it is most important to know the exact conditions over the ocean, especially in equatorial and certain other localities. We are glad to see that the Prince of Monaco has succeeded in interesting the Emperor of Germany in these questions, and that the cooperation of the German Navy in elucidating them appears to be assured.

Of the papers read at the optical convention in June last, a number of those having a special bearing on the microscope are abstracted in the *Journal of the Royal Microscopical Society* for October. In one of these papers, dealing with equivalent planes of optical instruments, Mr. Conrad Beck gives a simple explanation of the why and wherefore of the particular arrangement of lenses adopted in the compound microscope. A high-power microscope may have an equivalent focal length of only a few thousandths of an inch, but the plan of using lenses separated by large intervals gives an instrument in which the equivalent planes (*i.e.* the principal planes) are outside the system of lenses, thus allowing sufficient working distance between the front lens and the object.

In connection with Prof. Paul Harzer's recent communication to the British Association (*vide* Nature, October 26), we read with considerable interest an address delivered by him at the University of Kiel on the Emperor's last birthday, published by Lipsius and Tischer, of Kiel, dealing with the development of exact sciences in ancient Japan. In the Imperial Library of Tokyo there are no less than 2000 written and printed Japanese mathematical works extending back to the year 1595; and it is scarcely remarkable that the determination of the "Ludolphian Number" (Pi) played a prominent part in the thoughts of early Japanese mathematicians. In 1627 the approximation 79/25 was known, while in the second half of the seventeenth century values had been obtained which are correct to 9 or 10 places. The well known value 355/113 was known in 1709, and in 1722 and 1739 values correct to 49 and 51 places had been found. Among the early "circle squarers" Kowa Seki (1642–1708) occupied a leading place. His methods, which were applicable to circular arcs generally, depended on successive bisection, but in solving the quadratic equations by means of series the binomial expansion of the square root was used. During the eighteenth century four series for Pi were known to Naomaro Ajima, who also dealt with the ellipse. At the beginning of the nineteenth century Enzo Wada was acquainted with the catenary and cycloid, and it now appears proved that Seki and his immediate successors studied the binomial theorem, theory of numbers, the properties of maxima and minima, determinants, and spherical trigonometry. Of geodetical observations we have records dating from 1613, and these culminated in the measurements of arcs of the meridian by Ino Chukei (?) in 1800–1818. On the other hand, even as late as 1895, Prof. Harzer finds complaints of the neglect of higher mathematical study in Japan. The question as to how far the ideas of the early Japanese mathematicians were imported from the west through the medium of the Dutch trading ships or other means occupies a prominent part in Prof. Harzer's dissertation.

The twenty-fifth number (n.s.) of the *Transactions of the Oxford University Junior Scientific Club* contains, in addition to a list of the officers and new members and balance sheet, a paper by Mr. A. F. Walden on some recent views on the constitution of inorganic compounds, which gives an account of Werner's ideas as to the nature of complex cobalt and chromium salts. Mr. A. S. MacNalty deals with trypanosomiasis and sleeping sickness.

In No. 18 of the *Revue générale des Sciences* M. Bernard Brunhes, director of the Observatory of Puy-de-Dôme, gives an interesting account of recent work on terrestrial magnetism in central France. Notice is taken of the anomalies met with by workers in other countries, and particular emphasis is laid on the tendency of magnetic rocks to produce these effects. The Puy-de-Dôme affords an especially good example of the influence of magnetic rocks on the terrestrial magnetism of a district. A description is given of the method adopted in measuring the declination and inclination due to the permanent magnetisation of the specimens of rock selected for experiment.

The delegates of the Clarendon Press, Oxford, have published in pamphlet form, at sixpence net, an addendum to Mr. J. Cook Wilson's "On the Traversing of Geometrical Figures," which was reviewed in the supplement to our issue of October 19 (p. vi).

We have received from Messrs. A. Gallenkamp and Co., Ltd., of Sun Street, Finsbury Square, London, a copy of the fifth edition of their general chemical and scientific apparatus catalogue, which has been arranged to meet the requirements of the session 1905–6. The catalogue runs to 534 pages, and is profusely illustrated with clear and helpful illustrations. The arrangement of prices and details of sizes and similar facts in a simple tabular form throughout, and the concisely expressed descriptions of the forms of apparatus available, reduce the trouble of reference to a minimum. There is a good index provided also. Special attention may be directed to the section giving particulars of many forms of electrochemical apparatus, which should prove of interest to teachers and students of electrochemistry. The catalogue is worth examination by teachers who have charge of chemical and physical laboratories, and also by men of science engaged in research work. The excellence of this and other similar catalogues which have come before us recently is instructive evidence of the progress which has been made in the teaching of science in our schools and colleges.

OUR ASTRONOMICAL COLUMN.

COMET 1905*b*.—Further observations of this comet are recorded in No. 4056 of the *Astronomische Nachrichten*. As an error was made in the Bamberg record of R.A. on November 18, it became necessary for Herr Ebell to recalculate his elements and ephemeris, and the amended results are contained in Circular No. 81 from the Kiel Centralstelle. The corrected elements are as follows:—

$$T = 1905 \text{ October } 25{\cdot}7163 \text{ (Berlin).}$$

$$\left.\begin{aligned} \omega &= 132^\circ\ 34'{\cdot}9 \\ \Omega &= 222\ 55{\cdot}0 \\ i &= 140\ 37{\cdot}1 \end{aligned}\right\} 1905{\cdot}0$$

$$\log q = 0{\cdot}02188$$

The new ephemeris gives the position of the comet, at 12h. M.T. Berlin, on December 10 as $\alpha = 23$h. 30m. 53s., $\delta = -7^\circ\ 24'{\cdot}1$, but, as its brightness at that time will be only 0·07 of its brightness when discovered (mag. 7·5), the object will be a very difficult one to observe.

THE ANOMALOUS TAILS OF COMETS.—In No. 4, vol. xxii., of the *Astrophysical Journal* Prof. Barnard discusses the anomalous forms presented by the tails of comets. The generally accepted idea is that the tails are produced by the sun's repulsive force acting on the cometary matter, but, from a study of a number of photographs—more especially of Brooks's (1893) comet—Prof. Barnard has arrived at the conclusion that too much importance is attached to this cause, and that the eruptive action of the comet itself, and the active interference of external matter, should also be included amongst the tail-producing causes. Short, straight, minor tails, issuing from the nucleus at considerable angles to the main tail, seem to corroborate the existence of the comet's own eruptive force, or, at least, of some force in addition to that supplied by the sun.

The rapid deflections and distortions of the tail or tails, as in Brooks's comet, suggest the existence of some resisting medium which is not evenly distributed throughout interplanetary space, and such a medium would also explain the anomalous brightening up of some comets (*e.g.* Sawerthal's, May, 1888) and the disruption of such a comet as Biela's.

Finally, Prof. Barnard suggests that all bright comets possessing tails should be photographed hour by hour, as the day by day photographs hitherto obtained are separated by intervals so long that the changes recorded are not necessarily connected.

NOVA AQUILÆ NO. 2.—A number of photographs of the region about Nova Aquilæ, taken with the Bruce telescope, and with the 24-inch reflector of the Yerkes Observatory, are discussed by Mr. J. A. Parkhurst in the November *Astrophysical Journal*. These show that in the spring and summer of 1904 the Nova was at least fainter than the fifteenth magnitude.

The final mean value obtained for the position of the Nova for 1900 was

R.A. = 18h. 56m. 48·96s., dec. = $-4^\circ\ 35'\ 20''{\cdot}3$,

and a comparison of the images on different plates showed that the Nova was only slightly coloured.

A reproduction of one of the photographs taken with the 24-inch reflector (exposure, three hours) shows that the Nova is situated in a dark lane, almost devoid of stars, in a very rich field in the Milky Way, and also illustrates, in a very striking manner, the connection of Novæ with the galaxy.

CATALOGUE OF BINARY STAR ORBITS.—The results of a critical study of all published double-star orbits are published in Bulletin No. 84 of the Lick Observatory by Prof. R. G. Aitken.

The catalogue is divided into two lists, of which the first, relating to fifty-three stars, contains the elements of those orbits which Prof. Aitken considers to be fairly trustworthy. The second contains the names, the period, and the name of the computer of ninety-one stars of which Prof. Aitken considers the published orbits are too untrustworthy to be of any practical value.

A number of critical and explanatory notes relating to some of the individual stars accompany Prof. Aitken's catalogue.

INDIAN METEOROLOGY, 1892–1902.[1]

SIR JOHN ELIOT, in discussing recent meteorological phenomena, says:—"The period 1892–1902 was unique in the meteorology of India for the magnitude and persistence of the variations of rainfall, cloud, humidity and temperature from the normal."

This period can be divided into two parts, abnormal in opposite directions:—1892–4 characterised by excess of rain, cloud and humidity, and a reduced temperature, and 1895–1902 characterised by deficient rainfall, less cloud, drier air, and an average temperature above the normal.

The normal rainfall for three years (taking the average of 450 selected stations) is 123 inches, while the total rainfall for the period 1892–4 was 143·5 inches, an excess of 20·5 inches. The actual rainfall for the eight years 1895–1902 was 303·8 inches against the normal 328·7 inches, a deficiency of 24·9 inches.

During two years of this dry period the deficiency was so great over certain areas as to cause very severe droughts, which in turn caused famines. These two famines were, both in affected area and affected population, the worst during the last 150 years. The drought of 1896 and the famine of 1897 afflicted the United Provinces, Central Provinces, Central India, and Rajputana, an area of 300,000 to 400,000 square miles, 3,000,000 persons receiving relief. The drought of 1899 and the famine of 1900 affected South Punjab, Rajputana, Central India, Berar, Central Provinces, Hyderabad, Bombay Presidency and part of Orissa, Chota Nagpur, and Madras, an area of 600,000 to 700,000 square miles, and 6,500,000 persons required relief.

In discussing the meteorology of so large an area as India, it is impossible to detail all the local variations, but from among some examples given, Kilba, a station in the Simla district, may be mentioned. During the eleven years under discussion, Kilba for ten years received deficient rainfall, and instead of the normal 441·9 inches received 304·4 inches, the deficiency being equal to 3½ years' normal fall.

Using the data from 450 stations selected by the late Mr. Blandford as most trustworthy and representative, and giving due weight according to the area represented by each station, the average rainfall over India is given in inches:—1892, 46·18; 1893, 50·16; 1894, 47·56; 1895, 38·90; 1896, 36·26; 1897, 40·94; 1898, 41·52; 1899, 29·85; 1900, 40·52; 1901, 36·86; 1902, 39·04, the normal annual rainfall being 41·09 inches. The division of these years into a wet and a dry season is obvious.

On examining the amount of rainfall during the different seasons of the year, the fact is brought out clearly that all the seasons were affected by the abnormal conditions. During 1892–1894 all parts of the year had a tendency to excess rain. In 1893 the dry season had relatively more excess rain than the wet season. During the dry period 1895–1902 there was a tendency to deficiency of rain during all the seasons. Yet during a normal year the meteorological conditions which obtain during the wet season and the dry season are quite inverse of each other.

The persistence of the abnormalities through the seasons is also shown by the observations of cloud amount, humidity and temperature.

Discussing the geographical distribution of the rain, Sir John Eliot points out that during the wet period 1892–4 all parts of India received excess rain except in 1894, when the Bombay and Malabar district and the Madras district were deficient by 2 per cent. and 3 per cent. of the normal respectively. In 1892 the excess was more marked in those areas which received their south-west monsoon rain by the Bombay or Arabian Sea current, in 1893 and 1894 in those areas supplied by the Bay of Bengal current, and the excess was relatively greater in those areas which are near the interior limits of the fields of the two currents. The abnormal extension and strength of the monsoon currents are indicated by this excess in the interior.

During the period there was generally excess rain in

[1] "A Preliminary Investigation of the more Important Features of the Meteorology of Southern Asia, the Indian Ocean, and Neighbouring Countries during the Period 1892–1902." With Appendices. By Sir John Eliot, M.A., F.R.S., K.C.I.E. (Indian Meteorological Memoirs, vol. xvi. part ii.).

Baluchistan, Afghanistan, Persia, Zanzibar, and Mauritius, while the rainfall of Arabia, the Straits Settlements, and Port Blair was generally in defect. The defect at Port Blair is an illustration of the general rule that the rainfall of the Indian Sea area frequently varies inversely with that of the land area.

During the dry period 1895–1902 there was an almost continuous deficiency of rain over North Bombay, Central Provinces, Central India, and the Punjab. There was deficient rainfall for five years in Bengal, for four years in United Provinces and Madras, and for seven years in east and south Punjab. The interior districts suffered more than the coast, and those supplied by the Bombay current more than those supplied by the Bengal current. In 1899 the rainfall of North Bombay was 48 per cent. below the normal, and that of Rajputana and Central India 31 per cent. below. For five years out of eight these areas received at least 20 per cent. less rain than the normal.

The countries bordering on Indian area, and including Australia and South Africa, mostly suffered from want of rain.

During the wet period 1892–4 the monsoons were remarkable for the length of time over which they extended and for the persistence and steadiness of the monsoon conditions. In the dry period 1895–1902 the monsoons were generally characterised by their shortness. In 1896 and 1899, the years of drought, there was no prolonged delay in the commencement of the monsoon rains, but they stopped earlier than usual by three to seven weeks in the case of the Bombay current, and two to six weeks in the case of the Bengal current. This abrupt termination of the rains had a most disastrous effect upon the crops, especially in the Gangetic Plain and the Central Provinces. The crops dried and withered, and famine resulted.

The drought of 1896 was due in the United Provinces to scanty rainfall throughout the whole season, whereas in the Central Provinces and Berar it was due to the early termination of the rains. The year 1899 was characterised by the lack of heavy falls (*i.e.* falls of more than 3 inches in twenty-four hours) over all India, and especially so in the field of the Bombay current.

The data available show that the rainfall for all the countries which depend for their rain on the Indian Ocean was in excess during 1892–4, and in defect during 1895–1902. The rainfall over Russia, Turkestan, and Central Asia varied from the normal in the opposite manner.

The observations of cloud amount, relative and absolute humidity and temperature, show that the curves for these meteorological elements agree very closely with the curve for rainfall.

In discussing the variations of atmospheric pressure, Sir John Eliot refers to the important fact that the long-period variations as disclosed by barometric observations are similar in direction, amount and epoch over the whole of India, and gives both annual and monthly data showing this. Examination of the data giving the monthly variation of pressure from the normal shows that there were fairly long periods of continued excess or defect of pressure, that there was a decided oscillation of pressure. The period of oscillation is given as about two years. Sir Norman Lockyer and Dr. Lockyer, in a recent paper dealing with the rainfall of the Thames basin, refer to the annual pressure variation at Bombay, and speak of a 3·8-year period. Sir John Eliot gives a table showing the approximate dates of the changes from excess pressure and *vice versâ,* and notes that these changes almost invariably occur about the time of the change of season.

If these oscillations were due to exchange of air between the Indian Ocean and southern Asia, such as might accompany the seasonal changes, then the oscillations of pressure over these areas would be of similar period, but of opposite phase; but comparison of the Indian data with data from East Indies, China, South Africa, and Australia shows that this was not generally the case during 1895–1902. In 1893, when there was a deficiency of pressure recorded at Batavia, Singapore, Cape Town, Perth, and Adelaide, there was excess of pressure at Mauritius, Zanzibar, Hong Kong, and Zika Wei, and over India, but in other years, notably 1896, 1898, and 1899, there was a general agreement over the whole Indian Oceanic area and southern Asia. According to Sir John Eliot, this was not the case previous to the period under discussion. He says (p. 273):—" It was shown in the memoir [1] that the pressure variation at Mauritius from 1877 to 1889 presented long period oscillations or variations of similar period but opposite phases to the pressure variations in India," and also (p. 276) " the usual relation based upon previous investigations is for the pressure variations in Southern Asia to be of opposite character or sign to those of the Indian Oceanic region." Therefore he concludes that there was some great and abnormal movement of air affecting the barometric pressure over half the eastern hemisphere, but he has no data available to show the region where the opposite variation has taken place.

Sir Norman Lockyer and Dr. Lockyer, in their paper [2] on " The Similarity of the Short Period Pressure Variations over Large Areas," refer to a set of curves representing the pressure variations in Bombay, Colombo, Batavia, Mauritius, Perth, Adelaide, and Sydney, saying " the striking similarity between these curves shows that over the whole of this area, which includes both north and south latitudes, the same kind of variations is in action, and that therefore the whole region is intimately connected meteorologically."

These curves refer to the period 1874 to 1901. Attention might be directed to the fact that the term " long-period " seems to be applied by Sir John Eliot to variations which, when discussed by Sir Norman Lockyer, are called " short-period."

In another paper [3] by Sir Norman Lockyer and Dr. Lockyer two pressure curves are given, one for Bombay and one for Cordoba (Argentine), which are referred to thus:—" Dealing with the pressure of Cordoba during the high pressure months April to September, the curve representing the variation from the mean from year to year is exactly the inverse of the curve representing the Bombay and other Indian pressures for the same months over the same period of time. The cause therefore which raises the mean value for the low pressure months over the Indian area would appear to lower the mean value of high pressure months at Cordoba simultaneously. In fact we have a see-saw."

In a further paper [4] by the same authors, the surface of the globe is divided into two areas, one having the pressure variations of the Indian type and the other those of the Cordoba type.

These quotations show that there is evidently a difference of opinion on the question of the similarity or dissimilarity of the pressure conditions of Southern Asia, Australia, and Africa previous to the year 1892; and it is quite possible that the meteorology of these regions during the period, 1892–1902, was not so abnormal as Sir J. Eliot suggests.

From a discussion of the observations of variation of solar radiation, as indicated by the black bulb thermometer, Sir J. Eliot states that the data indicate that during 1891 to 1896 or 1897 there was an excess of solar radiant energy, and during 1898–1902 there was defect.

As such a defect would diminish the supply of aqueous vapour, and consequently the rainfall, accurate observations of the variations in solar radiation should give an explanation of the variations of the rainfall and air pressure. Observations by means of the black bulb solar radiation thermometers are, however, not considered very satisfactory.

Appendices to this important memoir give extracts from various official reports on the famines of 1897 and 1900 containing information with regard to the damage to crops and cattle. A large amount of data is also given referring to seasonal rainfall, rainy days, pressure, and dates of commencement and termination of the monsoon rains during the period discussed. Twenty-one plates of curves relating to the same observations form a not unimportant part of the volume which they conclude. W. M.

1 " Indian Meteorological Memoirs," vol. vi.
2 *Roy. Soc. Proc.*, vol. lxxi., p. 134.
3 *Roy. Soc. Proc.*, vol. lxx., p. 502.
4 *Roy. Soc. Proc.*, vol. lxxiii., p. 457

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THE section of physiology concerned itself very largely with the consideration of questions which are of practical importance to workers in South Africa at the present time. Such diseases as scurvy, leprosy, and plague offer problems which demand instant consideration, and in some cases legislation. The treatment of these maladies formed the subject-matter of papers by the medical officer for Cape Colony and his staff.

The diseases of cattle are at present of great importance in South Africa; they played a prominent part in the proceedings, both at Cape Town and at Johannesburg. The fate of the four colonies, but especially of Rhodesia, is intimately bound up with their value for rearing horses, cattle, sheep, and goats. In recent years, and more especially since the importation of stock from all parts of the world during and after the Transvaal war, several forms of disease have attacked the domestic animals of South Africa. The severity of these diseases may be judged from the fact that 97 per cent. of the horses at Umtali died of horse-sickness in a recent epidemic. No more pressing problems, therefore, than the cause and prevention of stock diseases present themselves to the students of pathology in South Africa. At Cape Town the morning of August 17 was devoted to their consideration. Two important communications were given by Mr. Hutcheon, principal veterinary surgeon for Cape Colony, and Mr. Lounsbury, Government entomologist in Cape Colony. Mr. Hutcheon's great experience of the subject, extending as it does from a time when the parasitic nature of these diseases was unknown, and his constant and successful efforts to combat successive devastations, render his communication especially valuable. In recent years Mr. Lounsbury also has done a vast amount of first-class work in connection with the habits and life-history of the various forms of tick which act as intermediate hosts for the piroplasmic organisms. At Johannesburg a very comprehensive paper on rinderpest was given by the Hon. George Turner, and one of much interest on horse-sickness and similar maladies by Dr. Theiler, principal veterinary surgeon of the Transvaal. Colonel Bruce's presidential address dealt also with stock diseases.

The importance of South Africa as a health resort occupied the entire sitting of August 16. Sir Lauder Brunton opened a discussion upon the effect of climate upon disease and upon health. Dr. Gregory and other South African medical officials took part in this discussion. Results also of great scientific interest upon the effect of high altitudes on health were given by Prof. Bohr, of Copenhagen. Mr. Barcroft described the outcome of recent researches upon the production of heat in the individual organs of the body, and indicated the bearing of these investigations upon the heat-formation of the body under varying climatic and dietetic conditions.

The morning of September 1 was devoted to purely physiological topics.

Some of the more important communications may be summarised as follows:—

August 16.—Discussion on the effect of climate upon health. Sir T. Lauder Brunton, F.R.S., pointed out that three primary points had to be thought of in considering climate, its effect (1) on the human body; (2) on the organisms which give rise to disease; (3) on the carriers of disease. After a detailed investigation of the effects of change of environment upon protoplasm, he showed that for every cell there was an optimum degree of humidity and of salinity; but more important than these was the optimum temperature. When the temperature of the body fell below 98°·4, the vitality, not only of muscle, but of every other tissue, became reduced. The amount of heat produced depended upon the activity of the tissues; the loss of heat largely depended upon the environment (especially the temperature and the humidity). The nature of the soil greatly affected the humidity, but often pathological conditions were put down to the climate which were attributable in reality to the effect of the geological structure of a locality upon its water supply; for instance, the constipation experienced by many persons at sea-side resorts in the south of England was not due, as often supposed, to the sea air, but to the calcareous water. Electrical conditions were referred to, especially the observations of Wier Mitchell and Dexter in America.

Dr. Gregory pointed to the prevalence of tuberculosis in South Africa, of which 17 per thousand of the natives and 7 per thousand of the white population died annually. On the other hand, scarlatina, small-pox, typhoid, and influenza existed in much milder forms than in Europe.

Prof. Bohr, speaking of the effect of high altitudes upon health, introduced the results of his most recent investigations upon the invasion and evasion coefficients of oxygen in contact with liquid surfaces, and used these coefficients to calculate the minimum barometric pressure which was consistent with adequate respiration. He showed how compensation was carried out at low pressures, which, however, were higher than the absolute possible minimum. The full account of his investigations appears in Nagel's "Text-book of Physiology"—article on respiration—to which the reader is referred.

Mr. Barcroft dealt with the heat production in the organs of secretion and excretion, and showed that these organs were responsible for a much greater share of the heat produced in the body than was formerly supposed. The following figures might be taken as representing our present knowledge of the heat formation per gram per minute of certain organs when at rest:—The submaxillary gland, 0·2 calories; the kidney, 0·15 calories; skeletal muscle, 0·02 calories. In climates, therefore, where the opportunity for heat loss was small (*e.g.* hot-damp climates) these organs should not be unduly taxed.

Other speakers were Dr. A. J. Mitchell, Prof. Sims Woodhead, Dr. Murray, and Prof. Halliburton, F.R.S.

August 17.—Mr. Hutcheon, principal veterinary surgeon, gave an historical account of the diseases which had devastated the stock of South Africa—pleuropneumonia, redwater, rinderpest, east coast fever, biliary fever, horse-sickness, &c. Of these, heartwater, rinderpest, and horse-sickness were the results of ultramicroscopic blood-parasites, whilst the redwater of cattle and the east coast fever were definite piroplasmic diseases. Ticks were responsible for the communication of heartwater, redwater, and east coast fever; horse-sickness was probably communicated by a mosquito. Mr. Hutcheon went fully into the means that were now taken for preventing these diseases. In the cases of redwater, heartwater, and rinderpest inoculation had been successfully carried out.

Mr. Hutcheon attributed the absence of horses in South Africa to the fact that zebras took horse-sickness, but not fatally, and thus the infection was kept alive.

Mr. Chas. P. Lounsbury, Government entomologist for Cape Colony, treated of ticks as a means of transmission of disease. The main features in the economy of ticks were first discussed. *Amblyomma hebraeum* is the tick responsible for conducting the heartwater of goats, sheep, and cattle. It therefore prevents the successful farming of wooled sheep and Angora goats over a considerable tract of the country. The tick becomes infected at one stage of its life-cycle and communicates the disease at another. The requisite condition of warmth is necessary during the metamorphosis of the tick if the disease is to be communicated. Sheep of the Persian breed take the disease more mildly than other varieties, and the virus is somewhat modified by passing through them. The progeny of the transmitting tick appears to be innocuous. *Haemophysalis leachi* is responsible for the communication of canine piroplasmosis. Unlike *Amblyomma hebraeum*, this tick only communicates the virus by means of adults which are the progeny of infected females. The virus, therefore, passes through the egg, and remains latent in the nymphal and larval stages.

African east coast fever is communicated, like heartwater, by the nymphs or adults of ticks which have themselves fed upon a sick animal. Five species of the genus Eurhipicephalus, viz. appendiculatus, nitens, evertsi, simus, and capensis, have been proved to carry this disease.

Other speakers in this discussion were Colonel Bruce, F.R.S., Sir W. Hely-Hutchinson, Mr. Robertson, Prof. Sims Woodhead, and Mr. Bowhill.

August 18.—Dr. Gregory gave a comprehensive paper recounting the deductions which he had been able to make touching the nature of scurvy as it exists in South Africa.

His main thesis was that the scurvy of South Africa is infectious in its nature, and probably of bacterial origin. It is subject to seasonal variation; it occurs in epidemics which vary in the intensity of their virulence. Its incidence is greatest amongst the native races, and it has a very high percentage of recurrences. An anti-scorbutic diet does not prevent it. It occurs where the diet contains a plentiful supply of fish and vegetables, and does not necessarily occur where these foodstuffs are deficient.

Dr. Mitchell gave a detailed history of the plague epidemics in Cape Colony. He showed that the plague in every case was introduced by rodents, and suggested more stringent measures to prevent the introduction of infected animals.

Dr. R. S. Black, formerly physician to the leper asylum at Robben Island, gave an account of leprosy in South Africa. He dwelt on the accumulation of evidence which existed in favour of leprosy being an infectious disease, and the absence of any data which had come under his notice in favour of this disease being due to the eating of fish. In the discussion which followed the paper Prof. Sims Woodhead pointed out the importance to patients themselves, and to the State, of removing any ambiguity as to the infectious nature of leprosy. It could not be too clearly understood by the native population that the policy of segregation was not prompted by one of a number of rival theories, but was the result of established facts.

On August 19 some of those who had attended the section enjoyed the hospitality of the Cape Government at Robben Island, where they were shown the admirable arrangements for treating the lepers.

Johannesburg, August 29.—The proceedings of the section opened with the president's address. This has been printed *in extenso* in the columns of NATURE; it is therefore unnecessary to refer to it here further than to say that it struck the key-note of the whole work of the day's sitting. Colonel Bruce dealt very fully with the stock diseases of South Africa from the purely scientific side. Those whose papers followed (the Hon. George Turner and Dr. Theiler) dealt with rinderpest and other stock diseases from the point of view of the practical student of the problems which these diseases offered to the farmers and to the executive of the Transvaal. The urgency of the situation which was caused by the rinderpest epidemics and the success of the means which were used to cope with them are shown, as Mr. Turner pointed out, by the fact that 986,518 animals are estimated to have been saved by inoculation. Roughly, four thousand five hundred litres of serum have been used for the inoculation at a cost of 7*l.* 10*s.* per litre. In some herds the method of "simultaneous injection" of virulent blood and immunising serum has been so successful that only 14 per cent. of the cattle have fallen victims to the epidemic, whilst 1·3 per cent. have been killed by the injection.

Dr. Theiler's paper dealt with stock diseases generally; the fact, however, that his name is so intimately connected with recent advances of knowledge into the etiology and prevention of horse-sickness accentuated the interest of that part of his communication which dealt with this disease. Briefly summarised, horse-sickness especially occurs in low-lying districts during the rainy season. Animals are infected only at night. The infection ceases as soon as the frost comes. The disease is inoculable in animals of the same species, but is not contagious. Horse-sickness is distinct from "blaau tongue" or catarrhal fever, which closely resembles it in most of the above characteristics. The virus of horse-sickness is easily destroyed by desiccation, but it is not affected by cold. Both the above diseases are conveyed from animal to animal by insects. Veterinary Surgeon Spreuill has succeeded, by hyperimmunising sheep with virulent blood, in producing a serum which is efficacious in cases of "blaau tongue." The author has achieved immunity against horse-sickness in mules and horses by simultaneous subcutaneous injection of serum and intravenous injection of virus.

August 30.—An interesting feature of the work of the section, and one for which it is much indebted to the officials, was a visit to the compound hospital, presided over by Drs. Louis G. Irvine and Donald Macaulay. As an introduction to the inspection, a paper was communicated by Dr. Macaulay and Dr. Irvine upon the conditions of native labour in the mines. They pointed out the great difficulty of persuading the native workers to care for their own health, to take even the simplest precautions, for instance, on coming up from the deep mining levels into the cold air. The death-rate was much lower than formerly, but it was still very high as the result of pneumonia and phthisis. The main problem, however, is that of acclimatisation.

Other papers were read by Dr. Leingme on diseases of natives, Dr. Maberley on the pharmacology of South African drugs, and Prof. McKendrick, F.R.S., on the effect of radium on the electric currents of the retina.

September 1.—Prof. Waller, F.R.S., gave an account of his recent researches into the means of estimating the percentage of chloroform vapour in air by means of the densimeter. He showed how frequently the cause of death was due, not to idiosyncrasy of the patient, but to an unsuspected increase in the dose of chloroform. This might occur whatever method was used, but it was specially likely to happen when the so-called "Edinburgh method" of administration with a towel was used. His experiments had shown in theory what had already been proved by practice, namely, that a mask covered with donette delivered the proper percentage of chloroform to the patient, namely, 2 per cent.

Dr. Pavy, F.R.S., read a paper for which the thanks of the section are due to him in an unusually large measure. The main thesis was based upon Dr. Pavy's well known view that the comparatively small molecules into which the food is broken down in the intestine do not exist in the blood as such. This view is the result of so much practical experience of the treatment of diabetes and of so much careful thought and accurate work that it must always command the respect of physiologists if not their adherence. The part of Dr. Pavy's paper dealing with the mechanism which exists for building up such molecules as sugar into the larger molecules of which they form but a small part was of a much more speculative nature. The author's view was that this function was performed by the lymphocytes, which took up sugar, &c., much as hæmoglobin acquires oxygen. The sugar is thus built up into the molecules of living protoplasm, and is subsequently imparted to the plasma and indirectly to the body.

Dr. M. Armand Ruffer gave a brief account of the evolution of the present knowledge of immunity artificially acquired. His own researches show that the serum of rabbits injected with human, bovine, or ovine urine dissolves *in vitro* the red blood corpuscles of that species of animals the urine of which has been injected. It is specific, *i.e.* has no action on the red blood corpuscles of any other species of animals. The author calls lysogen the substance which, when injected, produces a hæmolytic serum. Lysogen dialyses slowly, is not precipitated completely by alcohol, but wholly by saturation with ammonium sulphate or lead acetate. Simple exposure to air for one month or more destroys it, though it resists putrefaction and is not wholly destroyed by a temperature of 100° C. Urine contains hæmosozin or hæmosozins, *i.e.* a substance or substances preventing the action of hæmolytic serum. Some urines, *e.g.* human urine, prevent the action of serum dissolving human, bovine, and ovine red blood corpuscles; others, *e.g.* bovine urine, act only on a serum dissolving bovine red blood corpuscles. Dialysed urine is just as active as ordinary urine. Hæmosozin has practically the same physical and chemical characteristics as lysogen. Bile contains at least two groups of hæmolysins, and at least one hæmosozin. This hæmosozin is specific, *i.e.* prevents the hæmolytic action of the bile of that species of animals from which the hæmosozin was extracted, but not the biliary hæmolysins of any other species of animals.

The paper concluded by pointing out the necessity of making sera with isolated substances, and not with the crude products of bacteria. By injecting crude products it is more or less a matter of chance what the properties of the serum will be.

The proceedings ended at Johannesburg, as they had done at Cape Town, with an expression of thanks to the local officials of the section who had taken infinite pains to bring the meetings up to the high level of interest which they attained.

J. BARCROFT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—This week twelve of the larger colleges are holding their entrance scholarship examinations. They are divided into two groups of five and seven colleges respectively. Judging from the number of candidates, which is larger than ever before, there is an unprecedented desire amongst schoolboys to share in the endowments of Cambridge.

The annual dinner of the Cambridge Philosophical Society will take place on Saturday, December 9. It will be held in the hall of Christ's College, and Prof. Marshall Ward will be in the chair.

The regulations for the diploma in mining engineering have been published in the *Reporter* by the special board for physics and chemistry, together with the schedules of the proposed examinations.

The general board of studies has approved Dr. W. L. H. Duckworth, of Jesus College, for the degree of Sc.D.

The special board for biology and geology has adjudged the Walsingham medal for 1905 to Mr. W. S. Perrin, of Gonville and Caius College.

THE new buildings of the Glasgow and West of Scotland Technical College, which when completed will be the largest of the kind in Great Britain, are to be opened by the Marquess of Linlithgow, Secretary for Scotland, on December 21.

WE learn from *Science* that by the will of the late Mr. Joseph E. Gillingham, numerous bequests are made to educational institutions, including 10,000*l*. each to the University of Pennsylvania for the veterinary department, to Haverford College, to Swarthmore College, and to Bryn Mawr College.

THE *British Medical Journal* announces that Prof. Czerny has resigned the chair of surgery in the University of Heidelberg, which he has held since 1877, in order to devote himself entirely to the duties of director of the Institute of Cancer Research. He will be succeeded in the chair of surgery by Prof. Garré, who accepted a call to Breslau after the death of Prof. von Mikulicz.

A FEW months ago Sir Donald Currie offered a sum of 20,000*l*. to Queen's College, Belfast, provided a like sum was contributed by the friends of the college before the end of the present month. The sum of 3000*l*. was required to complete this contribution, and this has now been subscribed by Sir Otto Jaffe, chairman of the executive committee of the better equipment fund of Queen's College. The college will therefore now receive 40,000*l*. toward its better equipment.

AT the annual meeting of the court of Liverpool University on November 30, the Pro-Chancellor announced that the university would shortly receive from the executors of the late Mr. J. L. Bowes, of Liverpool, a sum of about 8000*l*., to be divided between the departments of modern languages and chemistry. A resolution was adopted to the effect that the decision of the court as to the formation of a school of military instruction be deferred until the court is in possession of fuller information as to the need of such a proposed school, and that meanwhile the council be requested to take no further steps towards its establishment.

THE new techno-chemical institute of the Charlottenburg Technical High School was opened on November 25 in the presence of a distinguished scientific audience, which included the Imperial Minister of Education, Dr. Studt, accompanied by Geh. Rat. Naumann and Freiherr von Thielmann, Profs. Emil Fischer, van 't Hoff, Landolt, Nernst, Beckmann, Will, von Knorre, Liebermann, and the following representatives of chemical industries:—Prof. Duisberg, Prof. Lepsius, Dr. Oppenheim, Dr. Knietsch, Dr. von Martius, Dr. Kunheim Kommerzienrat Brunck, Messrs. Birkeland, Eyde, Pettersson, and others. The new institute is a fine five-storeyed building, excellently equipped with the best of modern chemical laboratory arrangements and apparatus. The director, Prof. Dr. O. N. Witt, in his opening address, after dwelling upon the history and the aim of this, the newest addition to the Charlottenburg High School, detailed Birkeland and Eyde's method for the fixation of atmospheric nitrogen, and illustrated his account by an experiment carried out on a large scale. After the address the Educational Minister, Dr. Studt, decorated Prof. Witt with the Order of the Red Eagle, third class, and the architect, Dr. Körber, with the Order of the Red Eagle, fourth class.

A DEPUTATION from colleges connected with the teaching of agriculture who desired additional grants for research and higher education in agricultural science from the Imperial Exchequer was received by Sir Thomas Elliott at the Board of Agriculture on Tuesday. Sir Isambard Owen, the principal of the Armstrong College, Newcastle-upon-Tyne, stated the case on behalf of the deputation. It was urged that higher agricultural education was a public necessity, the cost of which could not be reasonably expected to be met in a very large proportion from local sources, and that they were amply justified in asking for State assistance. Sir Thomas Elliott, in reply, said that the Treasury had not hitherto met the demands of agriculturists illiberally altogether. Fifteen years ago the grant was 4500*l*., and now it was 10,550*l*. Of course, it was difficult to get increased local contributions owing to the increase of educational burdens upon local authorities. He quite agreed with the deputation that there was great room for the development of scientific research. There were great problems to be solved of an economic character which would produce results far beyond the cost of investigation or experiments. He thought the time had come for the coordination of the various agencies for agricultural research in this country. The Board had the fullest sympathy with the work which the colleges had done, and he hoped it would be able in some measure to meet their aspirations.

AT the winter session last week the General Medical Council considered the report of the education committee on the question whether the adoption of the following resolutions would not help to secure the attainment of the object which the council had in view in instituting the five years' curriculum:—"(1) That the preliminary scientific examination in physics, biology, and chemistry should be passed before the student begins the qualifying study of anatomy and physiology; (2) that before being admitted to the final examination the student should produce evidence that he has devoted the last year of his curriculum exclusively to practical and clinical work and study." The committee reported that the main effect of the proposed change would be seriously to lengthen the curriculum and thus to render entrance to the profession more difficult and expensive. At present the curriculum is far more often one of six or even more years—and this even in the case of industrious students—than one of five. With regard to the second resolution, the committee held that distinct evidence of clinical and practical study in the fifth year should be produced by the student, showing that his time in that period of his curriculum had been mainly occupied in such work, but they would not suggest any regulation which should absolutely limit the work of each session of the period of professional study. Dissatisfaction was, however, expressed with the committee's report, and the subject is to be re-considered. The two following questions were referred to the education committee to be investigated and reported upon:—(1) As to the desirability of transferring the preliminary science subjects of physics, biology, and chemistry from the curriculum of medical studies to a stage preliminary to the commencement of the curriculum; and (2) as to the advisability of requiring a five years' period of study, even after removing from the curriculum these preliminary science subjects.

THE report of the Board of Education for the year 1904–5 has now been published. After a general review of the work of the Board, detailed particulars of the following classes of schools are given in order:—public elementary schools, secondary schools and technical institutions, evening schools and schools of art. In the section dealing with secondary schools, the report lays it down that, "although it would be inexpedient and unjust to withdraw approval, and the support hitherto given, from those schools which have already been organised with a curriculum which is specialised from the first on the side of applied science, if

it can be shown that such a course is suitable to the circumstances of the locality in which the school is placed, yet it is not the intention of the Board to sanction the adoption of this special course in any fresh school." This decision is a little difficult to understand. If it can be shown at present that some schools, in which science takes a specially prominent part, are suitable to the locality in which the school is placed, it would appear reasonable to suppose that other localities in the future may demonstrate the need for a precisely similar type of school, and yet the Board has decided beforehand that—such demonstration notwithstanding—there shall be no more such schools. Experience has shown that the so-called "school of science" is capable of supplying just the training boys from elementary schools in manufacturing centres require to prepare them for their work in life, and it is to be hoped in these cases that every encouragement will be given to a definite course of study in science in the schools. All educationists of experience agree with the Board's opinion, expressed in subsequent paragraphs of the report, that premature specialisation in the work of ordinary secondary schools is to be discouraged, and that a well balanced curriculum, comprising literary and practical subjects taught in a scientific manner, is of prime importance; but such agreement does not preclude the possibility of applying special remedies to special needs. It is satisfactory to find that the report contains abundant evidence of a continued improvement in the work of secondary schools and technical institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Transit of Ions in the Electric Arc." By A. A. Campbell **Swinton.** Communicated by the Hon. C. A. Parsons, C.B., F.R.S.

The paper describes an experiment designed to show that in the electric arc the positive and negative electrodes emit carriers or ions which are respectively positively and negatively charged, and, after travelling across the arc, bombard the opposite electrode. The method adopted resembles that employed by Perrin to prove the negative charge carried by kathode rays. A small hole was pierced axially through one of the carbon electrodes, and immediately behind this aperture was fixed an insulated Faraday cylinder of brass which had its aperture in line with, and facing the aperture in, the electrode. A galvanometer connecting the insulated cylinder and the pierced electrode measured any difference of potential between the two. The second electrode was an ordinary carbon pencil, and as this was made positive or negative it was found that positive or negative charges respectively were communicated to the insulated Faraday cylinder, provided the arc covered the aperture in the pierced electrode, but not otherwise. These results, which confirm the theory as enunciated above, were obtained both in air at atmospheric pressure and also *in vacuo* up to what could be obtained with a mechanical air pump. The galvanometer deflections increased considerably with the degree of exhaustion, and at any given degree a much larger deflection was obtained when the second electrode was made negative and the cylinder was being charged negatively than when the contrary was the case, this corresponding with the known fact that negative ions have a higher velocity than have positive ions.

Geological Society, November 8.—Dr. J. E. Marr, F.R.S., president, in the chair.—The coast-ledges in the south-west of the Cape Colony: Prof. E. H. L. **Schwarz.** The author compares the shelves of Cape Colony with those described on the European and American sides of the North Atlantic, and he places the "absolute base-level of erosion" at 12,000 feet in North America, 8000 feet in Europe, and 1200 feet in South Africa. With these varying heights he correlates the topography of the bordering continents—the sharp divides, open river-valleys, permanent rivers and deltas, of Europe and America, where the movement has been downward and has almost reached bottom, in contrast with the flat undenuded divides, the steep, narrow gorges, the waterfalls, and the rocky river-gates, of South Africa, which is on the upgrade and probably near the top.—The Glacial period in Aberdeenshire and the southern border of the Moray Firth: T. F. **Jamieson.** One of the most interesting features in the glacial geology of Aberdeenshire is the Red Clay found along the eastern coast of the county. The purer masses of clay seem to have formed in a sheet of water lying in front of the ice, between it and the land, during the retreat of the Aberdeenshire ice, and at a time when the coast was submerged beneath water to a level exceeding 300 feet above the present coast-line. Evidence of the northward motion of the ice is given from striæ, the transport and removal of flints, and the bending-over of the edges of folia of gneiss. The Red Clay is underlain by a Grey Clay, and sometimes covered by a similar one. The author has recently discovered remains of a still older, dark indigo in colour, and containing small fragments of sea-shells. On the southern border of the Moray Firth the author gives examples of glacial marking on the rocks, and refers to the transport of boulders, including a huge mass of Oolitic rocks 40 feet thick, a mass of clay once considered to be an outlier of Lias, "pipe-rock," and the fossiliferous Greensand débris at Moreseat, now considered to have been transported by ice.

November 22.—Dr. J. E. Marr, F.R.S., president, in the chair.—On a new specimen of the chimæroid fish *Myriacanthus paradoxus*, Ag., from the Lower Lias of Lyme Regis (Dorset): Dr. A. S. **Woodward.** The author, having proved that the dorsal fin-spine of the so-called *Ischyodus othorhinus* is identical with an ichthyodorulite which has been named *Myriacanthus granulatus*, inferred that the larger ichthyodorulite *M. paradoxus* belonged to the same fish as the larger dentition named *Prognathodus Guentheri* by Egerton. This question has been settled by the discovery by Mr. S. Curtis, in the Lower Lias of Black Ven, of a dorsal fin-spine in direct connection with a mass of decayed cartilage, dermal plates, and teeth. The new fossil warrants the conclusion that Myriacanthus is a chimæroid, closely similar to the Upper Jurassic Chimæropsis, with (1) a median chisel-shaped tooth in front of the lower jaw; (2) a few tuberculated dermal plates on the head; and (3) a tuberculated dorsal fin-spine. In these respects it differs from all other known chimæroids—even from the comparatively primitive types which have been discovered during recent years in the Japanese seas. The Myriacanthidæ, in fact, have still no nearer ally than Callorhynchus, with which Egerton originally compared his so-called *Ischyodus orthorhinus*.—The rocks of the cataracts of the River Madeira and the adjoining portions of the Beni and Mamoré: Dr. J. W. **Evans.** The crystalline rocks of the cataracts of the River Madeira and the lower waters of its tributaries are part of a ridge with a north-westerly and south-easterly strike, similar to that of the Andes in the same latitudes. This strike is especially prevalent in equatorial regions. With the exception of comparatively recent alluvial deposits and a few pebbles of chert, pronounced by Dr. G. J. Hinde to be of marine origin, but uncertain date, only crystalline rocks are met with in the falls. They all appear to be igneous, and are mostly massive in character, though some dyke-rocks occur. In places they are typical gneisses, and they are often banded, but in some cases they show no signs of foliation. The prevailing type is acid, with a considerable proportion of alkalies, especially soda; but some of the rocks are distinctly basic in character.—The Doncaster earthquake of April 23, 1905: Dr. Charles **Davison.** The Doncaster earthquake of 1905 was a twin, with its principal epicentre half a mile north of Bawtry, and the other about 4 miles east of Crowle and close to the centre of the disturbed area of the Hessle earthquake of April 13, 1902. The distance between the two epicentres is about 17 miles. The disturbed area contains about 17,000 square miles, including the whole of the counties of Lincoln, Nottingham, Derby, Stafford, Leicester, and Rutland, the greater part of Yorkshire, and portions of Lancashire, Cheshire, Shropshire, Worcestershire, Warwickshire, Northamptonshire, Cambridgeshire, and Norfolk. The originating fault runs from about E. 38° N. to W. 38° S., and appears to be nearly vertical within the south-western focus and inclined to the south-east in the north-eastern focus. The first and stronger movement took place within the south-western focus. A twin-earthquake

is probably due to the differential growth of a crust-fold along a fault which intersects it transversely, the first movement, as a rule, being one of rotation of the middle limb, accompanied by the almost simultaneous slip of the two arches, and followed soon afterwards by a shift of the middle limb.

Zoological Society, November 14.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—*Exhibitions.*—(1) The mounted head and skin of a white water-buck (*Kobus ellipsiprymnus*) from British East Africa; (2) two mounted heads of the rhinoceros, one of which showed abnormal growth of the anterior horn, whilst the other bore four horns, viz. two on the nose, one between the ears, and one nearly at the back of the head: Colonel W. H. **Broun.**—(1) Specimens of a very rare and interesting marsupial, hitherto unique, in the Paris Museum, viz. *Dactylopsila palpator*, Milne-Edw., which differed from *D. trivirgata* by the extremely thin prolonged second finger; (2) two tusks which had been obtained by Baron Maurice de Rothschild during his recent expedition to Abyssinia: Hon. W. **Rothschild.**—Microscopic preparations of a new hæmosporidian from the blood of an African stork (*Leptoptilus crumeniferus*): A. S. **Hurst.** The exhibitor pointed out that this parasite belonged to the genus Halteridium, but differed from *H. danilewskyi* in its greater size (stade moyen 7–10 μ), and also in its method of sporulation, in which the merozoites were more numerous, smaller, and arranged in a ball-like rounded mass. The name *Halteridium crumenium* was proposed for the new species.—A letter from Mr. William Rodier, of Tambua Station, Cobar, N.S.W., concerning the continued success of Mr. Rodier's plan for counteracting the rabbit pest: Dr. P. L. **Sclater.** The plan consisted simply in catching the rabbits alive and killing the females only, letting the males go free.—The *Satyrus indicus* of Tulpius, said to be the type of the genus Simia: H. **Scherren.** Remarks were made with the view of showing that the animal was a gorilla, and was recognised before the middle of the eighteenth century as differing from a chimpanzee. The distinction between the *tschego* and the *ngina* was, he said, known in England in the first quarter of the nineteenth century.—*Papers.*—On the papillary ridges in mammals, chiefly primates: Dr. W. **Kidd.** The arrangements of the ridges on the hand and foot of twenty-four species were shown and described, and their functions discussed. Arguments were brought forward to show that their primary function was to increase the delicacy of the sense of touch. On the mammals brought back by the Tibet Mission: J. L. **Bonhote.** The collection was very small, containing examples of only some eight species, three of which were described as new, viz.:—(1) *Vulpes vulpes waddelli*, subsp.n. Similar to *V. v. flavescens*, but the whole coloration much brighter, especially the median dorsal area, which was deep red and markedly distinct from the colour of the flanks. (2) *Cricetulus lama*, sp.n. Allied to *C. phaeus*, but much greyer in general coloration, and the tail somewhat longer and stouter. (3) *Microtus* (*Phaeomys*) *waltoni*, sp.n. Closely allied in skull characters to *Ph. blythi*. The general coloration, however, was fulvous-grey, slightly greyer over the anterior part of the body.—Notes on the geographical distribution of the okapi: Dr. E. **Lönnberg.**—Observations on the Goral (*Cemas goral*) in Burma: Major G. F. **Evans.**—A collection of the mammals of Crete: Miss D. M. A. **Bate.** Examples of sixteen forms, of which six were described as new subspecies, were contained in the collection, and these were enumerated and remarked upon in the paper.

Physical Society, November 24.—Prof. J. H. Poynting, F.R.S., president, in the chair.—The dielectric strength of air: A. **Russell.** The author makes the assumption that for distances apart greater than about a millimetre when the disruptive voltage is V kilovolts the effective P.D. between the ends of the Faraday tube which is subject to the maximum stress is $V-\epsilon$, where ϵ is the minimum sparking voltage. Applying formulæ which he has deduced, using this assumption, to tests of Heydweiller, Steinmetz, Algermissen, &c., the author finds that they agree in making the dielectric strength of air 38 kilovolts per cm. approximately. A knowledge of this quantity enables us to find, not only the disruptive voltages between electrodes of many geometrical shapes, but it also enables us to find the "critical" pressure for overhead electric-power transmission at high pressures.—On the electrical conductivity of flames for rapidly alternating currents: Dr. H. A. **Wilson** and E. **Gold.** The following is a summary of the results:—(1) For rapidly alternating currents a flame containing an alkali salt vapour behaves like an insulating medium of high specific inductive capacity. (2) The conductivity of different alkali-salt vapours in a flame for rapidly alternating currents, as measured by the apparent capacity of platinum electrodes immersed in the flame, varies as the square root of the conductivity of the same salt vapours for steady currents. This result confirms the view that the negative ions from all salts have the same velocity. (3) The apparent capacity varies nearly inversely as the square root of the maximum applied P.D. (4) The apparent capacity is nearly independent of the number of alternations per second. (5) The apparent capacity is nearly independent of the distance between the electrodes. (6) The results (1) to (5) are in agreement with the ionic theory of the conductivity of the flame for rapidly alternating currents when the velocity of the positive ions and the inertia and viscous resistance to the motion of the negative ions are neglected in comparison with the effects due to the number of ions per c.c. (7) The apparent capacity per sq. cm. area of the electrodes is equal to $\sqrt{ne/8\pi V_0}$, where n is the number of positive ions per c.c., e the charge on one ion, and V_0 the maximum applied P.D. (8) Not more than one molecule in ten of salt molecules is ionised at any instant, but each molecule is probably ionised and re-combines several million times per second. (9) The steady currents observed through salt vapours in flames are very far from the maximum possible currents corresponding to the number of ions produced per second.—On the lateral vibrations of loaded and unloaded bars: J. **Morrow.** This is a continuation of the work previously communicated by the author on the vibration of bars of uniform and varying sectional area. By means of a method of continuous approximation the elastic displacement curves and the frequency of the lateral vibrations of bars can be determined to any required degree of accuracy. The method is first applied to some cases of unloaded bars, and also to massless bars carrying concentrated loads. The paper then deals with the principal problems of loaded bars which are themselves of appreciable mass.

MANCHESTER.

Literary and Philosophical Society, October 31.—Prof. W. Boyd-Dawkins, F.R.S., vice-president, in the chair.—On a biological aspect of cancer: F. J. **Faraday.** The author directed attention to a paper with this title read by him in 1899, and printed in vol. xliii. of the society's *Memoirs*. Several of the conclusions recently arrived at by the cancer research committee were therein foreshadowed, *e.g.* that cancer is not a microbic disease, but is due to an arrest of development and differentiation among the somatic cells, growth being restricted to mere gemmation.—Some recent researches into the nutrition of the egg cell in certain plants: Dr. Marie C. **Stopes.** The special group of plants on which the author worked was that including the pine trees, Ginkgo, and the Cycads, viz. the Gymnosperms. Though the egg cells in this group are in many ways different from those of the flowering plants, the results have some bearing on the question of nutrition of egg cells in general, as well as some points of general technique. Much of the work was done in conjunction with Prof. Fujii, of Tokio, with whom the author is publishing a joint paper on the subject in Germany.—A model to illustrate the propagation of sound waves: Dr. H. **Ramsden.** The model consists of a series of magnetised needles, suspended vertically so as to vibrate in the same plane with their like poles downwards, and is designed to show (since the needles were constructed and regulated to have equal times of oscillation) most of the phenomena of the longitudinal transmission of waves.

November 14.—Sir W. H. Bailey, president, in the chair.—Seaweed: C. L. **Barnes.** The author read some extracts from the classical writers which showed in how little esteem seaweed was held by the ancients, it being regarded by them as the most useless of things. He then showed, by an enumeration of some of the uses to which

seaweed is now put, that the moderns had effectually removed this reproach that had been put upon it.—An experiment showing some convection effects in a heated liquid: C. H. **Burgess.** A U-tube is filled in the lower half with hydrochloric acid coloured by a dye, and in the upper with plain acid, and the liquids are allowed to diffuse so as to give a shaded band. The liquid is then heated by the passage of an electric current, and is resolved into a series of well marked layers.

Paris.

Academy of Sciences, November 27.—M. Troost in the chair.—On the distillation of copper: Henri **Moissan.** Copper can be readily distilled in the electric furnace. When the vapour is condensed on a cool body, a felted mass of copper filaments is obtained, presenting all the properties of ordinary metallic copper. Copper at its boiling point dissolves carbon, graphite, partly crystalline and partly amorphous, separating out on cooling.—On the benzylidene derivatives of anthrone and anthranol: A. **Haller** and M. **Padova.** Amongst the reduction products of anthraquinone, Liebermann isolated a compound $C_{14}H_{10}O$, to which one of two formulæ could be assigned. The reactions described in the present paper show that this behaves as a tautomeric body, giving rise to derivatives of the ketone, anthrone.—Researches on intensive nitrification: A. **Muntz** and E. **Laine.** The principal aim of the present research was to find out a means of producing nitre on a large scale for the manufacture of explosives. Animal charcoal has been found to be the best support for the nitrifying organism when strong solutions of ammonium salts are employed, a litre of animal charcoal giving 8·1 grams of nitre per day. The maximum concentration of ammonium sulphate permissible has been found to be 7·5 grams per litre. It is shown that it would be possible to produce nitrates in quantities sufficient for the manufacture of explosives in the case of the external supply being stopped.—On the total eclipse of the sun of August 30, 1905: Ch. **André.** It is shown that the study of the eclipse by a series of micrometric measurements gave results at least as good as the direct determination of the times of the external contacts.—On the luminous intensity of the solar corona during the total eclipse of August 30, 1905: Charles **Fabry.** The observations were carried out at Burgos with a Lummer photometer. The intensity found was about three-quarters that of the full moon.—On groups of continuous curves: Maurice **Fréchet.**—On the non-uniform divergence and convergence of Fourier's series: H. **Lebesgue.**—On the coefficient of utilisation of helices: Edgar **Taffoureau.** A motor of 205 horsepower, working two helices of 7·767 metres diameter, can sustain a useful weight of 506 kilograms.—On the definition of the magnifying power of microscopical objectives: L. **Malassez.** The author proposes to define the magnifying power as the magnification produced by the objective at unit distance from its posterior face.—Researches on the purity of electrolytes. The determination of an upper limit of hydrolysis of concentrated saline solutions by the use of symmetrical liquid chains presenting a fresh surface of contact: M. **Chanoz.**—The difference of potential under which the kathode rays are produced: Jean **Malassez.** The author's experiments tend to show that, contrary to the views put forward by J. J. Thomson, the difference of potential under which the kathode rays are produced is the difference actually existing between the anode and the kathode.—The decomposition of ammonium sulphate by hot sulphuric acid in the presence of platinum: Marcel **Delépine.** In the presence of platinum, ammonium sulphate is destroyed by boiling sulphuric acid. The fact has an important bearing on the determination of nitrogen by the Kjeldahl method.—On a commercial silicide of copper: Paul **Lebeau.** A commercial specimen of copper silicide contained 51 per cent. of free silicon, 44 per cent. of copper silicide, and 4 per cent. of silicide of iron. The silicide was isolated, and, contrary to the accepted view, and in spite of the excess of free silicon, was found to consist of $SiCu_4$ instead of $SiCu_2$.—Chemical oxydases acting in the presence of hydrogen peroxide: G. **Baudran.**—The molecular refraction and dispersion of compounds containing the acetylenic grouping: Charles **Moureau.** It is shown that the additive law in the case of the molecular refraction and dispersion of substituted acetylenes does not correspond with the experimental facts.—The petrographical examination of some volcanic rocks from the Tuamotou Islands and Pitcairn Island: Albert **Michel-Lévy.**—On sterile fruits developed without the intervention of the male element: Th. **Solacolu.** The reserves accumulated at the base of the flower or in the neighbouring parts with a view to the normal development of the pistil after fertilisation are utilised in certain species, even when fertilisation has not taken place, with the formation of a false fruit.—On a new enemy of the coffee plant in New Caledonia: J. **Gallaud.** The disease is known locally as *Koleroga* or *Candellilo*, and is caused by a fungus, *Pellicularia Koleroga.* Statistical researches on the evolution of the height in flax: Mlle. M. **Stefanowski** and M. Henri **Chrétien.**—The cervical covering in the nauplius stage of *Artemia salina*: Nicolas **de Zograf.**—On a supposed case of reproduction by budding in annelids: Ch. **Gravier.**—The trophoplasmic spherules of the ciliated infusoria: J. **Kunstler** and Ch. **Gineste.**—Researches on a supposed ovulase of spermatozoids: Antoine **Pizon.** Pieri's theory, that the segmentation of the egg is started by a ferment (ovulase) of spermatic origin, has been examined experimentally under more rigorous conditions than those obtaining in Pieri's original experiments, and no evidence of the existence of such a ferment was obtained. The author's conclusion is that Pieri's experiments were not carried out with sufficient care.—The toxic power of the seminal fluid and general considerations on the poisonous character of the genital products: Gustave **Loisel.**—On the influence of the salts intimately related to the albumenoids and to the diastatic materials in proteolysis: G. **Malfitano.**—On the function of salts on the production of activity in the pancreatic juice: the specific action of calcium: C. **Delezenne.**—The oxidation of organic substances by ferrous sulphate in the presence of extracts of animal tissues: F. **Battelli.**—The emersion of the land during the Cretaceous period in Greece: Ph. **Négris.**—On the geological structure of the Cantabrian Cordillera in the province of Santander: Pierre **Termier.**—On the Carboniferous and Permian deposits in Corsica: M. **Deprat.**—The layer of fossil vertebrates of Maragha: M. **de Mecquenem.**—Measurements of the intensity of the earth's electric field and of the ionisation of the atmosphere during the total eclipse of the sun of August 30, 1905: G. **Le Cadet.**

Calcutta.

Asiatic Society of Bengal, November 1.—Some remarks on the geology of the Gangetic plain: E. **Molony.** The present valley of the Ganges in the United Provinces of Agra and Oudh has been excavated from an older alluvium, the eroding power of the river being due to submergence in the lower part of the course of the river at some remote period. The older alluvium sometimes forms islands in the midst of the newer alluviums, or Khadir, and is characterised by the presence of nodular limestone (Kankar). The boundary between the two formations is usually distinct. The main direction of the course of the river is determined by the channels in the older alluvium, erosion in which takes place very slowly. In stiff clay the average rate is 11 feet per annum. The records of the Lucknow boring indicate that the strata at a depth of more than 1000 feet are inclined, probably from north to south, and this is taken as evidence of a relative submergence of the southern portion of the Gangetic plain.

Note on the species, habits, and external characters of the dugong: Dr. N. **Annandale.** The author has examined a considerable series of Indian and Australian skulls and skeletons of Halicore. He regards the differences between them as individual, and sees no reason to recognise more than one species, *H. dugong.* He gives the measurements of a fully adult male recently caught in the Gulf of Manaar, and describes its external characters, especially those of the head and mouth. He points out that the dugong has probably altered its habits considerably within the last half-century, at any rate in Indian waters, and shows that its food includes true algæ.—*Hedyotis sisaparensis*, a hitherto undescribed Indian species: Captain A. T. **Gage.** Description of a new species of Hedyotis found by the author in the Calcutta Herbarium, from the Nilgiri district. It is most nearly related to *H. mollis*

(Wall.).—Materials for a flora of the Malayan Peninsula, No. 18: Sir George **King**, K.C.I.E., F.R.S., and J. S. **Gamble**, F.R.S. Owing to an unforeseen cause of delay, it has been found necessary to postpone the publication of the natural orders No. 75, Apocynaceæ, No. 76, Asclepiadaceæ, and No. 77, Loganiaceæ, for a short while; consequently the present part, No. 18 of the "Materials for a Flora of the Malayan Peninsula," contains the orders which succeed, viz. No. 79, Hydrophyllaceæ, to No. 85, Lentibulariaceæ, inclusive, together with No. 87, Bignoniaceæ, and No. 88, Pedalineæ. No. 78, Gentienaceæ, has already appeared in part xvii., and No. 86, Gesneraceæ, will come later on.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—The Periodogram and its Optical Analogy; with an Illustration from a Discussion of Observations of Sun spots: Prof. A. Schuster, F.R.S.—(1) On a Property which holds good for all Groupings of a Normal Distribution of Frequency for two Variables, with Applications to the Study of Contingency-tables for the Inheritance of Unmeasured Qualities; (2) On the Influence of Bias and of Personal Equation in Statistics of Ill-defined Qualities: an Experimental Study: G. Udny Yule.—On the Inheritance of Coat-colour in Horses: C. C. Hurst.—Further Experiments on Inheritance in Sweet Peas and Stocks (Preliminary Account): W. Bateson, F.R.S., E. R. Saunders, and R. C. Punnett.—A Biometrical Study of Conjugation in Paramæcium: Dr. Raymond Pearl. On Mathematical Concepts of the Material World: A. N. Whitehead, F.R.S.—The Determination of the Osmotic Pressure of Solutions by the Measurement of their Vapour Pressures: The Earl of Berkeley and E. G. Hartley. The Vertical Temperature Gradients on the West Coast of Scotland and at Oxshott, Surrey: W. H. Dines, F.R.S.—The Combination of Hydrogen and Oxygen in contact with Hot Surfaces: Dr. W. A. Bone, F.R.S., and R. V. Wheeler.—Fifth and Sixth Catalogues of the Comparative Brightness of the Stars: in Continuation of those printed in the *Phil. Trans.* for 1796–99 (Prepared for press from the original MS. Records by Colonel J. Herschel, R.E., F.R.S.): The late Dr. Herschel, F.R.S.—On the Cytology of Malignant Growths: Prof. J. B. Farmer, F.R.S., J. E. S. Moore, and C. E. Walker.—A Gas Calorimeter: C. V. Boys, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Partition of Bengal: Sir James A. Bourdillon, K.C.S.I.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Nitrites, Part I., Two Varieties of Silver Nitrite: P. C. Rây and A. C. Ganguli.—The Products of Heating Silver Nitrite: E. Divers.—Ethyl Piperonylacetate: W. H. Perkin, Jun., and R. Robinson.—A Contribution to the Chemistry of Saccharin: F. D. Chattaway.—The Action of Heat on α-Hydrocarboxylic Acids, Part II.: H. R. Le Sueur.—Studies on Optically Active Carbimides, Part II., The Reactions between 1-Menthylcarbimide and Alcohols: R. H. Pickard, W. O. Littlebury, and A. Neville.—The Action of Ultra-violet Light on Moist and Dried Mixtures of Carbon Monoxide and Oxygen: S. Chadwick, J. E. Ramsbottom and D. L. Chapman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Concrete Mixers: Dr. J. S. Owens.

LINNEAN SOCIETY, at 8.—On the Ætiology of Leprosy: Dr. Jonathan Hutchinson, F.R.S.—Some Notes on the Life-history of *Margaritifera Paneseae*: A. W. Allen.—*Exhibition*: Photographs of a Luxuriant Specimen of *Shortia uniflora*, in the Rock-garden of Mr. W. T. Hindmarsh, at Alnwick.

RONTGEN SOCIETY, at 8.15.—The Spontaneous Action of Radium and other Bodies on Gelatin Media: J. Butler Burke.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Results of Recent Investigations Relating to Sun-spot Periods: Prof. A. Schuster.—On the Present State of Lunar Nomenclature: S. A. Saunder.—On a New Method of Determining the Moon's Position Photographically: E. B. H. Wade.—Reproduction photographique des Réseaux photographiques: H. Bourget.—(1) Position of the Axis of Mars; (2) Comparative Charts of the Region following δ Ophiuchi: Percival Lowell. Comparison of the Results from the Falmouth Declination and Horizontal Force Magnetographs on Quiet Days in Years of Sun-spot Maximum and Minimum: Dr. Charles Chree.—Note on the Astronomical Value of Ancient Statements of Solar Eclipses: Prof. Simon Newcomb.—On the Conditions Determining the Formation of Cloud Spheres and Photospheres: A. W. Clayden.—On Testing Parabolic Mirrors; with some Results of the Tests as Applied to some Mirrors at Oxford: Rev. C. D. P. Davies.—*Promised paper*: On the Astronomical Observations recorded in the Nihongi, the Ancient Chronicle of Japan: E. B. Knobel.

MALACOLOGICAL SOCIETY, at 8.—(1) A Revision of the Species of Cyclostomatidæ and Liotiidæ occurring in the Persian Gulf and North Arabian Sea; (2) Description of Two Species of Marine Shells from Ceylon: J. Cosmo Melvill.—A Pteropod Alias: (*a*) C. Hedley, (*b*) E. R. Sykes.—(1) Descriptions of Four new Species of Marine Shells from Ceylon; (2) Description of a new Species of Physa from N.W. Australia: H. B. Preston.—Notes (1) on the Dates of Publication of J. D. Wilhelm Hartmann's "Erd- und Süsswasser-Gasteropoden," 8vo, St. Gallen, 1840; (2) On Some "Feeding Tracks" of Gastropods; (3) On Cement as a Slug-killer: B. B. Woodward.

MONDAY, DECEMBER 11.

SOCIETY OF ARTS, at 8.—The Measurement of High Frequency Currents and Electric Waves: Prof. J. A. Fleming, F.R.S.

TUESDAY, DECEMBER 12.

ZOOLOGICAL SOCIETY, at 8.30.

FARADAY SOCIETY, at 8.—The Physics of Ore Flotation: J. Swinburne and Dr. G. Rudorf.—The Concentration of Metalliferous Sulphides by the Flotation Process: Prof. A. K. Huntington.—The Ions of Pure Water: Prof. J. Walker, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion*: The Steam-Turbine: Hon. C. A. Parsons, C.B., F.R.S., and G. G. Stoney.—

WEDNESDAY, DECEMBER 13.

SOCIETY OF ARTS, at 8.—The Commerce and Industries of Japan: W. F. Mitchell.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 4.30.—*Probable papers*: An Investigation into the Structure of the Lumbo-sacral coccygeal Cord of the Macaque Monkey (*Macacus sinicus*): Miss M. P. Fitzgerald.—On the Distribution of Chlorides in Nerve Cells and Fibres: Prof. A. C. Macallum and Miss M. L. Menten.—The Mammalian Cerebral Cortex, with Special Reference to its Comparative Histology. I. Order Insectivora: Dr. G. A. Watson.—Observations on the Development of Ornithorhynchus: Prof. J. T. Wilson and Dr. J. P. Hill.—Further Work on the Development of the Hepatomonas of Kala-Azar and Cachexial Fever from Leishman-Donovan Bodies: Dr. L. Rogers.—The Action of Anæsthetics on Living Tissues. Part I. The Action on Isolated Nerve: N. H. Alcock.—Report on the Psychology and Sociology of the Todas and other Indian Tribes: an Abstract of Work carried out by the Aid of the Gunning Fund of the Royal Society for the year 1901–2: Dr. W. H. R. Rivers.—On the Sexuality and Development of the Ascocarp of *Humaria Granulata*, Quel.: V. H. Blackman and Miss Helen C. I. Fraser.—On the Microsporangia of the Pteridospermea with remarks on their Relationship to Existing Groups: Robert Kidston, F.R.S.—The Araucarieæ, Recent and Extinct: A. C. Seward, F.R.S., and Miss S. O. Ford.

MATHEMATICAL SOCIETY, at 5.30.—On Well-ordered Aggregates: Prof. A. C. Dixon.—Tables of Coefficients for Lagrange's Interpolation Formula: Col. R. L. Hippisley.—On the Representation of certain Asymptotic Series as Convergent Continued Fractions: Prof. L. J. Rogers.—On a New Cubic Connected with the Triangle: H. L. Trachtenberg.—Some Difficulties in the Theory of Transfinite Numbers and Order Types: Hon. B. A. W. Russell.—The Imaginary in Geometry: J. L. S. Hatton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Charing Cross Company's City of London Works: W. H. Patchell.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Seventh Report to the Alloys Research Committee: On the Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, and Messrs. R. A. Hadfield and Percy Longmuir.—*Paper*: Behaviour of Materials of Construction under Pure Shear: E. G. Izod.

PHYSICAL SOCIETY (at Royal College of Science, South Kensington), at 7.—Exhibition of Electrical, Optical and other Physical Apparatus.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests of Street Illumination in Westminster: E. E. Mann.

AËRONAUTICAL SOCIETY, at 8.—The Acoustical Experiments carried out in Balloons by the late Rev. J. M. Bacon: Miss Gertrude Bacon.—The Aeromobile: F. Webb.—A New Continuous Impulse Petrol Motor for Dynamic Flying Machines: W. Cochrane.

CONTENTS.

THURSDAY, DECEMBER 14, 1905.

A GREAT NATURALIST.

My Life: a Record of Events and Opinions. By Alfred Russel Wallace. Vol. i., pp. xii+435; vol. ii., pp. viii+459. With facsimile letters, illustrations, and portraits. (London: Chapman and Hall, Ltd., 1905.) Price 25*s.* net.

EVERYONE will be glad that the Nestor of the evolutionist camp has been able himself to tell us the story of his life. It has been a long life of over fourscore years, full of work, rich in achievement, starred with high ideals, and the story of it must have been pleasant to write as it is pleasant to read. It has been many-sided to a greater degree than that of most scientific investigators, for Alfred Russel Wallace has always had more than professional irons in the fire, and has always been as much interested in practising biology as in theorising about it At the editor's request we have confined our attention, however, to what the author tells us of his work as naturalist and biologist, though it is difficult, and not altogether legitimate perhaps, to abstract off one aspect of a life in this fashion.

There does not seem to have been anything definable in Wallace's inheritance to account for his becoming a great naturalist. Nor was there much in his nurture to lead him in that direction except that he was country-bred in beautiful and interesting places. Thrown early on his own resources to make his way in life, he began when about fourteen to work at surveying—in which Herbert Spencer had also his early discipline—and it was in trying to understand his instruments and the earth he measured that he first became scientific. He tells us that in his solitary rambles, nature gradually laid hold of him, claiming to be understood as well as enjoyed. From the stars and the earth his interest spread to flowers, and, with the help of Lindley's "Elements" and Loudon's "Encyclopædia of Plants," he became a keen field-botanist. He began to feel "the joy which every discovery of a new form of life gives to the lover of nature," and this was the turning-point of his life.

During a year of school-teaching at Leicester (1844), Wallace got to know Bates, who made him an enthusiastic entomologist, "opening a new aspect of nature," and he also read Malthus's famous essay, "without which I should probably not have hit upon the theory of natural selection." Another book that impressed him was Humboldt's "Personal Narrative of Travels in South America," which awakened a desire to visit the tropics, a desire soon strengthened by Darwin's "Voyage of the *Beagle*." It is interesting to find that as early as 1845 Wallace was speculating upon the origin of species, and had a warm appreciation of the "Vestiges of the Natural History of Creation."

Early in 1848, when he was twenty-five, Wallace set out, along with Bates, to explore and collect on the Amazon, and on the tale of his adventures, long since told, the "Life" throws some sidelights. There is a vivid description of the disastrous fire on board the rubber-laden ship which brought Wallace part of the way home in 1852. The holocaust of all his treasures was hard to bear, but what had been sent on during his journey, and those notes and drawings which were saved from the fire, sufficed to lay the foundations of his scientific reputation, and, perhaps, as he says, the disaster was, for him, a blessing in disguise, for it made him continue his *Wanderjahre*.

The "central and controlling" chapter in Wallace's life was his eight years' wandering throughout the Malay Archipelago, the story of which has fascinated many thousands of readers. He had found his vocation, and enthusiasm grew upon him. "Who ever," he wrote, "did anything good or great who was not an enthusiast?" The love of solitude grew upon him; it was so "very favourable to reflection." For though he was earning a competency by collecting, and though his knowledge of many groups of animals became expert, he was always pondering over big problems, and some of his friends at home shook their heads at his "theorising." "The problem of the origin of species was rarely absent from his thoughts," and at Sarawak, in 1855, he wrote what Huxley called a "powerful essay" on "The law which has regulated the introduction of new species"—a hint of what was coming. At Ternate, in 1858, when ill with intermittent fever, he began thinking over what he had learned from Malthus, and the theory of natural selection "suddenly flashed upon him." He wrote straight off to Darwin, and everyone knows how the two papers were read on the same day at the Linnean Society, and how the two discoverers were united in a friendship than which there has been nothing finer in the history of science.

From 1862 to 1871 Mr. Wallace lived in London, and the "Life" gives an account of his scientific and literary labours, and interesting glimpses of many scientific men whom he came to know, such as Lyell, Spencer, Huxley, W. B. Carpenter, and St. George Mivart. He tried for various posts, *e.g.* the secretaryship of the Royal Geographical Society (which Mr. Bates obtained), and the guardianship of Epping Forest (in connection with which he had some luminous ideas), but he was left free to continue his literary and scientific work, and to try to make things better for his country. Soon after his marriage, in 1866, he began to migrate by stages into the country—to Grays (where he wrote his "Geographical Distribution"), to Croydon (where he wrote his "Island Life"), to Godalming, to Parkstone, and was able to live quietly on his earnings and on a well-merited Civil List pension. Apart from his tour in America, where he gave the Lowell lectures in 1886, occasional holidays, *e.g.* at Davos, and occasional unprofitable scrimmages, his life was very uneventful, as men count events. By nature quiet, gentle, and reflective, he had no ambitions save for truth and justice; he was satisfied with plain living and high thinking, and the esteem of all who really knew him. Thus for many years he has cultivated his garden and served his fellowmen.

The "Life" contains many interesting appreciations of other naturalists, but we must confine ourselves to the relations between Darwin and the author. From his solitude in Malay Wallace wrote home in regard to "The Origin of Species":—

"I have read it through five or six times, each time with increasing admiration. It will live as long as the Principia of Newton. Mr. Darwin has given the world *a new Science*, and his name should, in my opinion, stand above that of every philosopher of ancient and modern times."

To Mr. Bates he wrote:—

"I do honestly believe that with however much patience I had worked and experimented on the subject, I could *never have approached* the completeness of his book, its vast accumulation of evidence, its overwhelming argument, and its admirable tone and spirit. I really feel thankful that it has *not* been left to me to give the theory to the world."

As everyone knows, Wallace parted company with Darwin over the possibility of giving a "natural history" interpretation of man's highest qualities, and in one of his letters Darwin expressed the fear that his selectionist interpretation would quite kill him in Wallace's good estimation. But the author writes:—

"I never had the slightest feeling of the kind he supposed, looking upon the difference as one which did not at all affect our general agreement, and also being one on which no one could dogmatise, there being much to be said on both sides."

Wallace also differed from Darwin in regard to the reality of sexual selection through female choice, as to the distribution of Arctic plants in south temperate regions, as to the feasibility of the provisional hypothesis of pangenesis, and as to the transmissibility of acquired character. On the whole, however, he admits that those critics are not far wrong who describe him as more Darwinian than Darwin, and even in the title of one of his most effective books he persisted in his magnanimous subordination of himself. The fact is, the friends were too keen in the pursuit of truth to trouble about the boundaries of their personal credit. Neither begrudged the other his due meed of praise. Thus, if we may quote once more, we find Darwin writing to Wallace:—

"I hope it is a satisfaction to you to reflect—and very few things in my life have been more satisfactory to me—that we have never felt any jealousy towards each other, though in some sense rivals. I believe I can say this of myself with truth, and I am absolutely sure that it is true of you."

In addition to his statement of the theory of natural selection, his travels, and his work on distribution, Mr. Wallace has in many ways enriched natural history in the wide sense. There is his theory of the "warning colours" of inedible insects, his theory of the correlation between the colours of female birds and the nature of the nest, his theory of "recognition-marks," his criticism of sexual selection by choice on the female's part, his argument that much that is called "instinctive" is due to instruction and imitation, his conclusions as to the Arctic elements in south temperate floras, his emphasis on mouth-gesture as a factor in the origin of language, his strong opinions as to the part natural selection has played and still plays in the social evolution of mankind. We might mention other contributions—as to the permanence of oceanic and continental areas, as to the causes of glacial epochs, as to the glacial erosion of lake-basins, as to the affinities of the Australian aborigines—but we have said enough. It may be of interest, however, to notice that while Wallace many years ago sided with Weismann, he cannot see his way to recognise the validity of the recent theories of discontinuous variation and mutation.

In thinking of the work of Alfred Russel Wallace, we see him as a "synthetic type," combining the virtues of the old naturalist traveller with those of the modern biologist. On the one hand, we see him with a rich experience of the forms and species of animal life, their distribution, habits, and inter-relations, but with a wide outlook, equally interested in palms and orchids, lakes and mountains. With "a positive distaste for all forms of anatomical and physiological experiment," he never took to any of the usual methods of analysis, and even when he was most preoccupied with species he tells us that he was determined not to become a specialist. So, on the other hand, we see him from first to last as a generaliser, "inquisitive about causes," intent upon "solving the problem of the origin of species," and contributing much thereto. His "Life" also discloses what many have had the privilege of knowing—the delightful personality of one who has had the honour of being "Darwinii æmulum, immo Darwinium alterum," and no ætiologist merely, but a warm-hearted humanist thinker, a fearless social striver, and one who realises the spiritual aspect of the world. He has the satisfaction of a retrospect on a long and happy life of work.

J. A. T.

A HIGHER TEXT-BOOK OF ELECTRICITY AND MAGNETISM.

Magnetism and Electricity for Students. by H. E. Hadley. Pp. x+575. (London: Macmillan and Co., Ltd., 1905.) Price 6*s*.

THE object of this volume is to carry students a stage further than that reached in the author's "Magnetism and Electricity for Beginners." It has been written in response to numerous requests from teachers. Its scope is roughly that of a second- or even third-year college course. Elementary differential and integral calculus is employed, but even this is avoided whenever reasonably practicable. Technical applications are dealt with in a minor way only, the author considering, rightly in our opinion, that they are best relegated to a special treatise.

Turning to the detailed treatment we find many things to attract us. The method adopted for describing electrical phenomena may be alluded to as the "lines of force method." There are a large number of carefully thought out diagrams showing the play of Faraday tubes in various cases. These are in the main very accurate and suggestive as sketch diagrams. In Fig. 112, however—illustrative

of Faraday's ice-pail experiment—care should have been taken to make the lines emanating from the charged ball fall normally upon the vessel. The properties of these lines are not dogmatically asserted, but in general are derived, in the usual way, from the inverse square law of force; exception must, however, be made with respect to the lateral pressure exerted by such tubes. In stating that the inverse square law was experimentally verified first by Coulomb the author seems to have forgotten Cavendish, who, fully twelve years earlier, proved that the index cannot differ from two by more than 1/50th part.

We have alluded already to the diagrams; more care than usual has been exercised in regard to these. We are particularly attracted by one showing the lines of force and induction of a horse-shoe magnet. Compared with the usual paltry sketches of these lines this is most excellent. The student ought to be warned, however, that it represents rather an artificial case, since the poles are taken as concentrated at points. In the absence of this warning the student may be puzzled to account for the peculiar configuration of the system of lines shown. Another diagram which is now finding its way into text-books is one (Fig. 354) showing the lines of *electric* force due to a current. Much emphasis is usually placed on the magnetic field, but the electric field is almost entirely ignored. We are glad to see it now beginning to take its proper place. It may be mentioned that if the conductors be taken as infinitely deep, so as to reduce the problem to a two-dimensional one, the lines of force are a family of rectangular hyperbolæ, while the equipotential lines are the orthotomic hyperbolæ.

Several omissions and errors require attention. In the chapter on mechanics there is no definition of *mass* we are not even told that it is the quantity of matter in a body. It is erroneous to state that electrification and electric currents are forms of energy (p. 22). A hollow soft iron cylinder does not act as a perfect screen to magnetic force for points inside it (p. 65). The proof of the formula for the ballistic galvanometer (p. 282) is imperfect, since it assumes that the current is constant while it flows; whereas it essentially is never so in cases for which this kind of galvanometer is used. A very little change in the proof will put this right. In the formula for simple pendulum or suspended coil the time period should not be written with $\sin\theta/\theta$ in the denominator, since when so written the idea is conveyed that this is the proper form when the difference between $\sin\theta$ and θ is too large to be neglected. In calculating the temperature of a wire when heated by a current the emissivity should not be taken as a constant, for Messrs. Ayrton and Kilgour confirmed Péclet's proof that it depends on the radius; for very thin wires the values go up to many times that quoted, except, of course, in a vacuum. Kelvin's proof of the existence of an E.M.F. *distributed* in a circuit of two metals parts of which are at different temperatures depended on the first law of thermodynamics, and not upon the properties of a Carnot cycle (p. 374). The definition of units is antiquated; those described (p. 515) are now obsolete. On p. 531, in connection with displacement currents the word *displacement* is used on adjacent lines in two senses, with consequent confusion to the meaning. The treatment of the calculation of the propagation of electrodynamic effects (p. 534) which is professedly applicable to the case when the exciting current is travelling along a wire is inapplicable to this case. The display of mathematics in this calculation will convey the erroneous impression of a thorough investigation. The result must be disastrous to a student who is feeling his way toward a knowledge of the subtleties of line-integration round a closed curve. The error arises in part from forgetting that the magnetic induction varies in the direction y as well as in the direction x. Everything is, we believe, put right if the conductor be taken as an infinite plane sheet; the variation which is omitted is in such a case zero.

These few errors are the more unfortunate since we think that the book will prove a very useful one. We frankly think that it has been attempted to put too much into small compass; most sections would be improved by amplification in explanation of principle at the sacrifice of detail. A little excision when this edition is exhausted, a little more attention to logical order and to the development of principles—such suggestions are worth attending to, for the book has the making of a very useful volume.

BUNSEN'S COLLECTED WORKS.

Gesammelte Abhandlungen von Robert Bunsen. Edited by Wilhelm Ostwald and Max Bodenstein. Vol. i., pp. cxxvi+535; vol. ii., pp. vi+660; vol. iii., pp. vi+637. (Leipzig: Engelmann; London: Williams and Norgate, 1904.) Price *2l. 10s.* net.

THE appreciative and critical notices of Bunsen and his work which appeared shortly after his death hardly leave room for a review of the volumes before us. In the Chemical Society memorial lecture, which is justly given the place of honour in the prefatory part of the first volume, Sir Henry Roscoe has given a comprehensive survey of Bunsen's work, and has described the personality of the man in such a way as to earn the gratitude of all old Heidelberg students.[1]

In these three stately volumes we have a complete collection of Bunsen's contributions to science and a book that will form part of the permanent literature of chemistry. It is, indeed, a most striking fact that all Bunsen's writings are in their nature permanent scientific literature, a fact that well deserves pondering at the present time. He made some mistakes, he advanced some conclusions now untenable, but his writings are of faithful observations, careful experiments, laboratory methods. Of speculative theory there is nothing, and of strictly polemical writing also nothing. The books that are included in his writings are accounts of methods of doing things that he him-

[1] An account of Bunsen's scientific work was given by Sir Henry Roscoe in NATURE of April 28, 1881 (vol. xxiii. p. 597), as a contribution to our series of "Scientific Worthies."—EDITOR

self devised—gas analysis, mineral water analysis, flame reactions. It is not easy to describe Bunsen's relation to chemical science. He was a perfect type of "Naturforscher," a word for which there is hardly an English equivalent. He lived in his laboratory, ever absorbed, he seemed, in finding his way through natural problems, like a navigator always on the bridge sailing in an unknown archipelago. His writings are hardly more than his log, and his lectures were the narratives of his own particular voyage in the region called chemistry. To a listener who had a fair knowledge of chemistry and its literature it seemed as if there were no part of inorganic chemistry which Bunsen had not made in some way his own. In the laboratory it was the same; from the making of a borax bead to the execution of the most complicated analysis there was the Bunsen method of doing things. Spectroscopy, gas analysis, and electrolytic chemistry for long seemed wholly his. No chemist had a broader or more philosophical outlook than he; on the one hand he had a profound distrust of theory that went in advance of experiment, and on the other hand he despised all kinds of aimless or recipe work. Of the periodic classification of the elements he said at one time, "Ja, solche Regelmässigkeiten findet man in den Börsenblättern"; of a well known standard work on analysis he said "Koch-buch!" and indignantly ordered its removal. What a memorable experience it was for a student to work with Bunsen through the Russian Mint residues! The innumerable devices of his own, the "nursing" operations at different stages, the tales of his earlier efforts and disasters, the eager hope "vielleicht steckt etwas neues darin," the dry assurance "ja, alle Wochen werden ein Paar neue Platinmetalle entdeckt" all these things come to mind to recall the image of a man in whom the art of a past master was combined with the artlessness of a child.

It is impossible to estimate the influence of such a man; but in the volumes which it is the object of this notice to commend, it is possible to read the record of his work and to catch something of the spirit which animated the worker.

The collected works are published under the auspices of the German Bunsen Society for Applied Physical Chemistry, and are edited by Prof. Ostwald and Dr. Bodenstein. We are therefore assured that the task has been performed with pious care and with fulness of knowledge. The original intention of publishing a biography of Bunsen had to be abandoned owing to his express order, so characteristic, that his literary remains should be destroyed. He also desired that from his own letters in the possession of others nothing of a personal character should be published. The gap thus left is probably not so great as might be imagined, and one feels, after reading the prefatory memoirs by Sir Henry Roscoe, Dr. Rathke, and Prof. Ostwald himself, that we have probably all we really need to know. "Bunsen stories" were doubtless good to those who knew him, but to those who did not they were apt to be like most tales of university dons, and the collection which has been privately published seems rather trivial, and jars somewhat on the ears of the faithful. But the collection of his writings makes a noble monument, and the thanks of all chemists are due to the Bunsen Society and to the two editors who have undertaken the laborious task and have executed it so well.

ARTHUR SMITHELLS.

OUR BOOK SHELF.

The Practical Study of Malaria and other Blood Parasites. By Dr. J. W. W. Stephens and S. R. Christophers. 2nd Revised Edition. Pp. iii+396 and xliv. (London: Published for the University Press of Liverpool by Williams and Norgate, 1904.) Price 12s. 6d. net.

THIS volume gives a very full and complete account of the practical methods employed in the study of malaria and kindred protozoan diseases of man and animals. The book being intended primarily for the use of medical men in the tropics, who may be far from any laboratory, abounds in practical hints and suggestions which will enable good work to be accomplished with a minimum of apparatus, &c.

The methods of making and staining blood-films are given very fully, and the appearances of normal blood and of the various malaria parasites carefully described. In connection with malaria, the methods of catching, breeding, keeping, and feeding mosquitoes for purposes of malaria study receive considerable attention, and the life-history of the mosquito and the characters of a number of the more important species have no less than 200 pages devoted to them. Chapters then follow on the clinical and epidemiological study of malaria, and finally the hæmamœbidæ, trypanosomes, spirochætes, and filariæ are considered. This entails descriptions of the anatomy and classification of the chief species of ticks, fleas, tsetse and other biting flies, and a mass of detail is thus brought together in a form required by the investigator for which he otherwise would have to search in many scattered papers and works of natural history. In this respect the book will be of great value in laboratories of medical protozoology and the like. There are few points to which exception can be taken, for the book is the outcome of the authors' own experience on the subjects of which they write. It may be doubted, however, if methylated spirit can take the place of methyl alcohol for making up the Leishman blood-stain, and the authors' view that blackwater fever is malaria plus hæmoglobinuria excited by chill, quinine, or other simple cause is open to question.

The book can be recommended as a most valuable guide, and the numerous illustrations, diagrammatic though many of them are, enhance its usefulness.

R. T. HEWLETT.

Pictures from Nature. By Richard and Cherry Kearton. Portfolio of fifteen Rembrandt photogravures. Size 15in. × 11in. (London: Cassell and Co., Ltd.) Price 10s. 6d. net.

THE remarkable photographs taken by the Brothers Kearton of animal life in many aspects have often been described in these columns in terms of the highest praise. The fifteen pictures of birds and othe animals, among their natural surroundings, reproduced for the present portfolio, represent the highwater mark of faithful portraiture in natural history.

The plates include the following subjects:—Black throated diver, kittiwakes at home, leverets in their form, kingfisher waiting for its prey, squirrel, puffins

at home, young willow wrens, ring dove or wood pigeon, young cuckoo and sedge warblers, hedgehog, young long-eared owls, gannet or solan goose, peewit or lapwing, sparrowhawk adding sticks to her nest, and the great tit or oxeye.

These handsome pictures provide the best possible tribute to the patient power of silent watching which the Brothers Kearton have developed during the last thirteen years in order to take advantage of opportunities of photographing animals in their natural surroundings.

Meteorologie und Klimatologie. By Prof. Dr. Wilhelm Trabert. Pp. 127; with 37 figures in the text. (Leipzig: Deuticke, 1905.) Price 5 marks.

In this little book, which forms part xiii. of Prof. Klar's "Die Erdkunde," the author attempts to outline the general principles of meteorology and their application to the study of climate in a single work. The meteorological elements, and the making and reducing of observations are first dealt with; next comes a section on atmospheric physics, the distribution of temperature and its variations, the circulation of the atmosphere, evaporation and condensation; and, finally, a section on weather and climate, which includes chapters on weather forecasting, the chief types of climate, and the climatic characteristics of the main land divisions of the globe.

Where so much is attempted in so small compass, there is, of course, constant risk of the treatment of parts of the subject becoming hopelessly inadequate, but Prof. Trabert has succeeded in avoiding this; the essential points are selected with extraordinary skill and presented with great clearness and conciseness. The omission of details of construction of instruments in part i. is especially satisfactory—most books on meteorology are overburdened with matter which is only wanted by practical observers—although in some cases more modern types of instrument might have been selected for illustration. The most successful section of the book is, in our opinion, that on atmospheric physics, in which the vertical distribution of temperature and the forms of isobaric surfaces are given the prominence they deserve, but do not always get.

Prof. Trabert's book is an excellent introduction to such classics as Hann's "Lehrbuch" and "Klimatologie," on which it is to a certain extent modelled, and we strongly commend it to elementary students and teachers.

A Popular Introduction to Astronomy. By the Rev. Alex. C. Henderson. Pp. 114. (Lerwick: T. and J. Manson, 1905.) Price 2*s.* 6*d.* net.

In this book there are three chapters, occupying sixty-three pages, and a series of thirteen "notes" which take up the remainder of the text. In chapter i. we find a very general, yet simple and instructive, description of the solar system, its probable origin, and the nature, appearance, dimensions, and distances of its various individual components. The explanations given are brief, but they are lucid, and the verbal illustrations are homely enough to appeal to the simplest minds. Chapter ii. deals with the apparent and real motions of the heavenly bodies, and here again the beginner should find no difficulty in grasping the fundamental ideas. Comets are discussed in chapter iii., which really consists of a description of Biela's famous comet and of the meteoritic genesis of these bodies.

The thirteen "notes" comprise a *mélange* apparently consisting of extracts and examples taken from the author's note-book, and it is rather difficult to see to what class of reader they will appeal. Portions of them are certainly too erudite to suit real beginners, whilst they are not of the form to appeal to more advanced students. For example, the observing of the sunrise, combined with the consultation of a year book, would hardly answer to the description of an "accurate method" of determining time. Double stars, climatic variations, auroræ, eclipses, the lunar phases, and the zodiac are amongst other things dealt with in this section of the book. W. E. R.

Fragmenta Phytographiae Australiae occidentalis. By L. Diels and E. Pritzel. Pp. 608. (Leipzig: W. Engelmann, 1905.)

Although the floras of the different Australian colonies present a certain homogeneity that unites them into a definite "Flora Australiensis," there is also a considerable diversity between the floras of the eastern and western sides of the continent; that of the western half is distinguished by its richness, the singular modifications due to physical conditions and the large proportion of endemic species. Exclusive of the northern tropical region, the vascular plants of Western Australia, according to the evidence of the Government botanist, Mr. A. Morrison, do not fall far short of 4000 species, and most of these are found in the south-west. The writers of this volume travelled through this portion of the colony, and also penetrated into the interior from Geraldton to Cue, and as far as Ranowna and Menzies in the Coolgardie district. Phytogeographical limits are determined mainly by the rainfall, which reaches a maximum of 39 inches in the neighbourhood of Cape Leeuwin and diminishes rapidly to 9 inches at Shark Bay in the North and Southern Cross inland; the botanical provinces outlined in this volume have been mapped out in accordance with the rainfall.

The book is primarily a systematic compilation of the authors' collections, and although there are interesting notes on morphology and habit, the principal feature is the intimate knowledge which the authors display of the distribution of the various species. A revised arrangement of the Verbenaceæ is given, with analytical keys and numerous illustrations. Additions have been made to most of the typical genera, to mention only Acacia, Drosera, Hibbertia, and several of the Myrtaceæ. Taken in conjunction with Bentham's "Flora Australiensis," Baron von Mueller's "Fragmenta," and Spencer le Moore's notes, these "Fragmenta" provide the necessary data for a fairly complete flora of the colony. Dr. Diels proposes to write a continuous phytogeographical account later, wherein it may be expected that he will summarise the extraordinary modifications of the desert and other plants that are no less unique than those of the Egyptian desert flora which Volkens has so vividly portrayed.

Sporting Sketches. By E. Sandys. Pp. vii+389; illustrated. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1905.) Price 7*s.* 6*d.* net.

Mr. Edwyn Sandys is so well known to bird-lovers and sportsmen in general by such works as "Upland Game Birds" that any volume of a somewhat similar nature is almost sure of a hearty reception on the part of that section of the public to which it more specially appeals. In the volume before us the author has collected together a number of articles on sporting subjects which originally appeared in that excellent American sporting magazine *Outing*, and to these he has apparently added others which now see the light for the first time. Whether, however, new or old—and the author seemingly gives us no clue on this point—the articles have such a freshness about

them, and savour so strongly of the prairie or the river bank, that the lover of an outdoor life must be hard indeed to please if he cannot find matter of interest on almost any page to which he may happen to turn. The chapter-headings in some instances appear to be designed, at least to an English reader, to conceal rather than to elucidate the author's subjects, and we venture to think that some less recondite titles than "The Witchery of Wa-Wa" and "A Matter of Mascalouge" might have been selected without detriment to the picturesque style which the author apparently favours. But when once this little difficulty has been overcome, the reader will be able to find his way about the book, and select those sections in which he may be more specially interested.

The greater part of the book is devoted to fishing—both in sea and river—and feathered game shooting, and the English reader who desires to know the kind of sport afforded by ruffed grouse and "bob white" will find his requirements fully satisfied in the author's pages. Nor will the naturalist fail to find matter well worth his notice; and personally we have been specially interested in the account of the death-feigning instincts exhibited by the Carolina rail. Seemingly, when it thinks itself unable to escape, one of these birds suddenly "stiffens, topples over, and apparently expires. It may be taken up and examined for a considerable time without its betraying any signs of life. Place it among its dead fellows in the shooting-boat, and after a longer or shorter interval it may astonish its captor by either starting to run about, or by taking wing and fluttering away in the characteristic flight."

This is only one of many instances where strange habits of animals are recorded, and if not new they are always interesting and worth the re-telling. As a sample of the better class of sporting literature Mr. Sandys's work would be difficult to beat. R. L.

Ships and Shipping. By Commander R. Dowling. With a preface by Lieut. W. G. Ramsay Fairfax, R.N. Second Edition. Pp. xv+423. (London: A. Moring, Ltd., 1905.) Price 5s. net.

A very excellent little volume and a most handy addition to any shipping office. The naval information makes it also a very useful book to naval officers. One slight improvement would be useful—port-to-port distances round the coast of Great Britain and Europe; for example, London to Plymouth.

H. C. Lockyer.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The late Sir John Burdon-Sanderson.

The account of the life of Sir John Burdon-Sanderson in Nature of December 7 is so admirable that any addition to it may seem superfluous. Yet, as one who knew Burdon-Sanderson for more than thirty-seven years, and who owed more to him than language can well express, I shall be grateful if you will allow me to say a few words more about him. It seems to me that in one respect men may be likened to mountains. The Matterhorn rises sharply to a single peak, and there can be no doubt as to its summit. Monte Rosa has more than one summit, so nearly on a level that a stranger would be unable to say which is highest, and although each is higher than the Matterhorn, the enormous bulk of the mountain takes away from their apparent height and makes them less imposing. In the same way it is easy to say what the great work has been of any man who has distinguished himself in a limited subject, but when a man's work ranges over a wide sphere it is not so easy. The account of Sir John Burdon-Sanderson's life in last week's Nature clearly shows the wide extent of his activity and the great number of epoch-making discoveries which he made. If a scientific man were asked which of these is the greatest, he would probably answer according to his own personal bias. One man would name his unique researches on motion in plants; another his discovery of the possibility of attenuating anthrax virus and thus producing immunity from the disease; a third his researches on circulation and respiration; and a fourth his work on muscle and nerve. But all these things, important as they are, each one being sufficient to make a man famous in a special department, were only isolated outgrowths of his great work, and did not constitute it. I believe that I am right in saying that Burdon-Sanderson's life-work may be defined in three short sentences:—(1) He revolutionised physiology and pathology in this country; (2) he found them consisting of book-learning and microscopic observation; (3) he left them experimental sciences.

When he first constructed a kymographion in 1867 by the aid of a tin-plate worker near the Middlesex Hospital, to which he was then attached, there was not, with the exception of a few specimens of Marey's sphygmograph, a single recording physiological instrument in use in the whole of this country. Now they are to be found in every physiological laboratory, and every student knows how to use them. When he began to work at pathology, it consisted chiefly in descriptions of the naked-eye and microscopical appearances of specimens of morbid anatomy. Now the action of disease-germs and of toxins and the reaction of the organism to them, the processes of disease and not its results, engage the chief attention of pathologists, and the knowledge which experiments on these processes have afforded regarding the means of producing immunity and of curing by antitoxic sera has lessened, and is daily lessening, the wholesale destruction of life by epidemic diseases.

How Burdon-Sanderson accomplished his great work by his researches, by his writings, by his example, and by his personal influence was well described in last week's Nature, but I may perhaps be permitted to mention my own case as an example of what Burdon-Sanderson did for young men. I came to London knowing only one man, who from age and infirmity was unable to help me; but fortunately for me I had a letter of introduction to Burdon-Sanderson. Instead of merely saying a few civil things and then leaving me alone, as he might well have done, he invited me to his house, advised me as to my career, obtained for me a lectureship in the Middlesex Hospital, to which he was then attached, gave me the free use of his laboratory, afforded me facilities for both experimental and literary work, and, in short, laid for me the foundation of any success I may since have had, so that it is mainly to him that I owe it. How many there are whom he has treated as he did me I do not know, for he did not let his left hand know the good his right hand was doing, but I do know that at least two others, Dr. Ferrier, who has done such splendid work in physiology, and Dr. Klein, who has done the same in pathology, owe, like me, their first establishment in London to Burdon-Sanderson. Such personal help as this in enabling young men to pursue a scientific career must not only be regarded as an evidence of the kindness and benevolence of his character, but must be reckoned along with his researches, his writings, his example, and his personal influence as a means whereby he accomplished his great work of revolutionising physiology and pathology in this country.

Lauder Brunton.

Nomenclature of Kinship; its Extension.

The method I adopted in your columns, August 11, 1904, of briefly expressing kinship has proved most convenient; it has been used in a forthcoming volume by Mr. E. Schuster and myself on "Noteworthy Families." I write now to show that it admits of being *particularised* by the use of foot-figures, as in the following example, which

refers to the more highly placed relatives of the newly elected King of Norway.

Haakon VII., King of Norway (*b.* 1872).

fa_{1s}	Frederick, Crown Prince of Denmark (*b.* 1843).
$fa_{1s}\ fa$	Christian IX., King of Denmark.
$fa_{1s}\ bro_2$	George I., King of the Hellenes (*b.* 1845).
$fa_{1s}\ si_2$	Dagmar, widow of Alexander III., Tsar of Russia, who *d.* 1894
$fa_{1s}\ si_2\ son_1$	Nicholas II., Tsar of Russia (*b.* 1868).
$fa_{1s}\ si_1$	Alexandra, Queen of England (*b.* 1844).
$fa_{1s}\ si_1\ son_1$	George, Prince of Wales (*b.* 1865).
$fa_{1s}\ si_1\ da_3$	also *wife*, Princess Maud (*b.* 1869) of England.

The formulæ are to be read thus:—"his (the K. of Norway's) father is the 1st (eldest) son, and is Frederick, C.P. of Denmark; "his (the K. of Norway's) father's father is Christian IX."; . . . "his father's 2nd sister's 1st son is Nicholas II."; . . . "his father's 1st sister's 3rd daughter, who is also his (the K. of Norway's) wife, is the Princess Maud." These foot-figures need not interfere with the simplicity of the general effect, while they enable a great deal of additional information to be included.

FRANCIS GALTON.

Atomic Disintegration and the Distribution of the Elements.

MR. DONALD MURRAY'S letter (p. 125) deals with a subject which I have been attempting, now for more than a year, to attack experimentally. A similar experience to that which Mr. Murray describes as the experience of a lifetime occurred to me eighteen months ago in a visit to the gold mines of Western Australia. Since then my thoughts have been less concerned with the radio-elements than with those like gold, platinum, thallium, indium, &c., which resemble radium in the minuteness and approximate constancy of the proportion in which they occur in nature.

It is wonderful to reflect that mankind for thousands of years has been passionately and determinedly engaged in the search for gold, not on account mainly of its useful qualities, but on account of its comparative scarcity. The history of gold-getting presents a strange uniformity. The search has been rewarded always with about the same qualified measure of success, never with such success that the value of gold has seriously depreciated. The common saying that about the same amount of gold has to be put into the earth in order to dig it out holds an economic and probably a scientific truth. For may we not consider that the history of these centuries of search, carried on with a tenacity of purpose and a continuity approached in the case of no other element, shows clearly that a natural law is here involved no less than in the case of radium or polonium? The history of gold-getting appears to be substantially the same in all countries in all times. We have the initial prospecting in which the chances and difficulties are so great that only the most adventurous attempt it; the discovery of surface gold and the rush from all parts of the earth; the phenomenal finds and the invariably much greater proportion of failure; the tracing of the gold to its source and the discovery of some cubic acres, or it may be miles, of gold-bearing earth. Then at first only the deposits averaging several ounces to the ton are thought worthy of attention; but these rapidly give out, and attention is directed to the poorer and still poorer veins, while at the same time the steady progress and evolution of the pioneer camp, where often gold seems to be commoner than water, into the civilised community served with railways, electric power, and often elaborate water supply, cheapens the cost of extraction to such an extent that deposits averaging only a few grains to the ton can be made to yield a profit. Finally, we have the same inevitable end when science and organisation have done all in their power, and the remaining ore contains just so much gold as *not* to pay.

Let the case be stated a little differently. What would be the effect of the sudden discovery in any one place of some really large quantity of gold? There seems no doubt that utter chaos would ensue in the commercial world, which might involve before it was got under control a re-arrangement of the map of the world. Since nothing of the sort has ever happened, in spite of the most unprecedented struggles to that end, it is in accord with the principles of natural evolution to conclude that such a contingency probably violates some law of nature. Thus the gentlemen in charge of the national exchequer and of the Bank of England, who on a casual examination appear to be placing the most blind and implicit confidence on the future continuance of the existing order of things, are in reality secure in a fundamental if previously unrecognised law of nature. Eighteen months ago, after my visit to the gold deposits of Western Australia and New Zealand, and by the information which all concerned in the industry so readily placed at my disposal, I became convinced that in all probability gold, like radium, is at once the product of some other parent element, and is itself changing to produce "offspring" elements, so that its quantity, and hence its value, was fixed simply as the ratio of these two rates of change.

My experiments with gold have been both by the direct and indirect methods. The former have been dogged by misfortune and have so far been without result, while in the indirect experiments on ancient gold the results until now have been conflicting. Certainly some nuggets did not contain helium in appreciable quantities, while in others I did find a minute quantity of helium. This, however, was before the elaborate precautions afterwards employed had been adopted, and as I can now repeat the experiments with certainty as soon as occasion permits I am keeping a quite open mind. On the other hand, I have established to my own satisfaction that helium is an invariable constituent of native platinum in all the samples I have tried. The above reasoning, from rarity, after extended search, applies to platinum to a degree only less complete than in the case of gold.

The experiments with the other elements have not yet been proceeding long enough to have furnished results, but I have made a great many experiments with uranium and thorium in the attempt to detect directly the production of helium from these elements. These elements have been, in fact, the standards, for their rate of change is accurately known, and, assuming with Rutherford that the α particle is an atom of helium, may be expected to yield helium at a known rate. The methods of search have been perfected in the case of these two elements, and I am glad to be able to say that it is now only a question of time and patience before the rate at which helium is being produced from these two elements is accurately measured. On the other hand, if helium is not being produced, the experiments will indicate a maximum possible limit of the rate of production (set by the smallest quantity of helium detectable) far below the rate to be expected from theory. This method, which is, of course, applicable to any other element, would detect any other gas of the argon-helium family if produced. So far, however, I have only had one completely successful experiment with each element. In the case of uranium the result was positive, and indicated a rate of production of the same order as that required by theory. In the case of thorium, the experiment was of the nature of a blank test, and it proved that the rate of production is certainly not greater than ten times that required by theory.

Mr. Murray's letter induces me to put on record these imperfect results, and I do this the more readily as they may perhaps serve to emphasise and support his suggestion that experiments along the lines and on the scale he suggests should be carried out. But what laboratory in England could deal with ten tons of lead over a term of ten years?

After a year's work, I confess I am less hopeful than I was of the ability of the individual worker to carry out direct experiments in this subject of atomic disintegration. I wonder if the individual with his humble kilogram and his single lifetime is not starting on an almost forlorn hope, and is unduly and unnecessarily handicapped. Due consideration should be given to the supreme consequences that must follow from successful discoveries in this field. Not only is there to be considered the effect such results must exert on the whole trend of philosophic thought, but certain definite economic problems would be solved. For example, the proof of the disintegration of gold would reduce the doctrine of bimetallism and the theory of

currency to a branch of physical science, while in the mining industry the results would possess a fundamental significance. For the first time in the history of mineralogical chemistry it is possible, thanks to the researches of Boltwood, Strutt, and McCoy, to predict with considerable certainty the percentage of one element (radium) present if the percentage of another (uranium) is known; and one asks to what this discovery may not grow.

It seems to me that the individual and his single lifetime is too small a stake for the prize in view. Such a work should be national, and carried on from century to century if necessary; and what nation has such a right or such a duty as the one in which the subject of atomic disintegration originated? I confess to a feeling of impatience, to the sense of the inadequacy of the single lifetime, in my experiments on such small quantities of gold as I can purchase, when, disintegrating at the same rate, if disintegrating at all, tons of gold are lying useless in the national bank, their secret—possibly one that it much concerns the race to know—guarded from knowledge by every cunning invention that the art of man may devise. I confess to a sense of indignation that I should have to purchase for my experiments coins and other objects of known antiquity when within the walls of the National Museum lie—mere dead relics as they at present are—one of the finest collections in existence, capable of affording evidence perhaps of a longer history than any dreamed of by the antiquarian, and guarded by those who cannot interpret the cypher, and who, officially at least, are unaware of its existence. I confess to a feeling of misgiving in starting experiments where, on the scale possible to the individual, the chances are all against their yielding a positive result in a lifetime. Surely considerations of this character, the availability of the national resources and antiquities for the purpose of scientific investigations under due safeguards, and the provision for and care of experiments of long period with great quantities demanded by this new subject, are worthy of the attention of the nation, and of the British Science Guild as its newly formed adviser. Frederick Soddy.

The University, Glasgow, December 9.

The suggestion which Mr. Murray has put forward (p. 125) in explanation of the constancy of association of lead and silver has occurred to me also, and is indicated in an article which will probably appear shortly in the "Jahrbuch der Radioactivitat und Elektronik"; some calculations are contained therein which may be of sufficient interest to justify reproduction here.

Some recent experiments[1] have afforded evidence that the activity of the ordinary metals is caused by the emission of α particles. On the assumption that these α particles have an ionising power similar to that of those from radioactive elements, it appears that lead should emit less than one such particle per second. In order to find the maximum rate of change that we can attribute to this metal, we will assume that the emission of one such particle involves the breaking up of one atom of lead and the formation of one atom of silver; thus one atom breaks up per second. Now a gram of lead contains about 4×10^{21} atoms, and therefore to transform one ten-millionth part of the lead would require 4×10^{14} seconds or more than ten million years. Since it would be impossible to detect a smaller proportion than this by chemical tests, I fear that the experiment which Mr. Murray suggests is impracticable. The earth would probably have ceased to be a habitable globe by the time that the lead was ripe for examination; perhaps we may trust posterity to settle the matter with greater expedition!

But the slowness of the change in lead presents serious difficulties to the theory that the silver in galena is a disintegration product. Even so small a proportion as one in ten thousand ($3\frac{1}{2}$ ounces to the ton) would mean that the silver had been accumulating for a thousand million years—a period longer than that usually assigned as the age of the earth. But until we know more of the processes by which deposits of ore were formed, it is impossible to say whether the lead could have retained its silver through all the vicissitudes of its career. I believe that the silver cannot be separated from galena by any physical means; it may be so intimately associated that geological processes cannot affect it; but against this we have to set the fact that cerussite often contains much less silver than the galena from which it is obviously derived. But here chemical separation may have taken place involving the passage of the metals into solution.

There are problems connected with the "traces of impurity" constantly associated with certain minerals which await solution by some laborious chemist; it would be interesting to see whether there is any tendency to proportionality like that which holds between uranium and radium. But the absence of such a relation might be explained on the grounds that radio-active equilibrium had not yet been attained.

There is one other point to which attention may be directed. Rutherford has shown that the loss of heat from the earth by conduction would be compensated by the energy evolved by radium distributed throughout the mass of the earth in the ratio of 1 to 2×10^{13}; it appears that this amount of energy might be supplied by the disintegration of the actual constituents of the earth even if no radium were present. It is becoming clear that the older estimates of the age of the earth, based on physical data, are wholly erroneous; but if the radio-activity of all elements can be established rigidly, and the time constants of their decay measured with sufficient accuracy, it may be possible to use the evidence to which Mr. Murray has directed attention to gain some information as to the period that has elapsed since the solidification of the earth's crust. Norman R. Campbell.

Trinity College, Cambridge, December 10.

[1] The accounts of these should be included in an early number of the *Philosophical Magazine*.

In Nature, December 7, p. 125, Mr. Donald Murray suggests that the constant association of different elements arises from the slow transmutation of one into the other. The idea is certainly a reasonable one, and I presume has long been in the minds of all who have followed recent work. The writer discussed this question last year (*Chem. News*, 1904, lxxxix., 47, 58, 118), and arrived at Mr. Murray's opinion.

Now interest in the matter is reviving, perhaps I may be allowed to direct attention to this discussion.

Kiel, December 10. Geoffrey Martin.

Action of Wood on a Photographic Plate.

I have recently seen some photographic plates used at the last eclipse which have on them, not only pictures of the sun, but also pictures of the wood forming the dark-slides in which they had been placed.

At a former eclipse I understand a similar disaster occurred. It may, therefore, be well for me again to state that wood in contact with, or in near proximity to, a photographic plate, even in the dark, can impress upon the plate a clear picture of itself.[1] This action is much stimulated by high temperature and brilliant sunshine. It can, however, be stopped in several ways; probably the simplest one would be to make the slides of copper in place of wood. William J. Russell.

Davy-Faraday Laboratory.

Magnetic Storms and Auroræ.

The interesting paper by Dr. Chas. Chree in your issue of November 30 (p. 101) is inaccurate in one particular. He states that the storm of November 12 was not accompanied by auroræ. My friend Mr. John McHarg, of Lisburn, writes me that "it was fairly prominent, to be seen easily above the moonlight, the usual type, a steady glow brighter than the Milky Way, extending half round the horizon and fading off upwards at an altitude of 20°, or 30° in the west."

From that station auroræ were also observed on November 14, 15, 16, 17, 20, 21, 22, 23, 26, 27, and 30, and it is reported also that a bright crimson arch was seen on the early morning of December 1.

F. C. Dennett.

6 Eleanor Road, Hackney, N.E.

[1] *Phil. Trans.*, vol. cxcvii. p. 281; *Proc. Roy. Soc.*, vol. lxxiv. p. 131.

NOTES ON STONEHENGE.[1]

IX.—FOLKLORE AND TRADITIONS.

SO far in these notes I have dealt chiefly with stones, as I hold, associated with, or themselves composing, sanctuaries. We have become acquainted with circles, menhirs, dolmens, altars, viæ sacræ, various structures built up of stones. Barrows and earthen banks generally came afterwards.

The view which I have been led to bring forward so far is that these structures had in one way or another to do with the worship of the sun and stars; that they had for the most part an astronomical use in connection with religious ceremonials.

The next question which concerns us in an attempt to get at the bottom of the matter is to see whether there are any concomitant phenomena, and, if there be any, to classify them and study the combined results.

Tradition and folklore, which give dim references to the ancient uses of the stones, show in most unmistakable fashion that the stones were not alone; associated with them almost universally were many practices such as the lighting of single or double fires in the neighbourhood of the stones, passing through them and dancing round them; there were also other practices involving sacred trees and sacred wells or streams.

Folklore and tradition not only thus may help us, but I think they will be helped by such a general survey, brief though it must be. So far as my reading has gone each special tradition has been considered by itself; there has been no general inquiry having for its object the study of the possible origin and *connection* of many of the ancient practices and ideas which have so dimly come down to us in many cases and which we can only completely reconstruct by piecing together the information from various sources.

I now propose to refer to all these matters with the view of seeing whether there be any relation between practices apparently disconnected in so many cases if we follow the literature in which they are chronicled. We must not blame the literature since the facts which remain to be recorded now here, now there, are but a small fraction of those that have been forgotten. Fortunately, the facts forgotten in one locality have been remembered in another, so that it is possible the picture can be restored more completely than one might have thought at first.

It will be noted at once that from the point of view with which we are at present concerned, one of the chief relations we must look for is that of time, seeing that my chief affirmation with regard to the stone monuments is that they were used for ceremonial purposes at certain seasons, those seasons being based first upon the agricultural, and later upon the astronomical divisions of the year.

But in a matter of this kind it will not do to depend upon isolated cases; the general trend of all the facts available along several lines of inquiry must be found and studied, first separately and then *inter se*, if any final conclusion is to be reached.

This is what I now propose to do in a very summary manner. It is not my task to arrange the facts of folklore and tradition, but simply to cull from the available sources precise statements which bear upon the questions before us. These statements, I think, may be accepted as trustworthy, and all the more so as many of the various recorders have had no idea either of the existence of a May year at all or of the connection between the different classes of the phenomena which ought to exist if my theory of their common origin in connection with ancient worship and the monuments is anywhere near the truth.

This question of time relations is surrounded by difficulties.

I give in Fig. 23 the Gregorian dates of the beginning of the quarters of the May year, if nothing but the sun's declination of 16° 20′ N. or S., four times in its yearly path, be considered. These were:—

	May Year	Greek Calendar	Roman Calendar
End of Winter ... ... / Beginning of Spring ...	Feb. 4	Feb. 7	Feb. 7
,, Summer ...	May 6	May 6	May 9
End of Summer ... ... / Beginning of Autumn ...	Aug. 8	Aug. 11	Aug. 8
,, Winter ...	Nov. 8	Nov. 10	Nov. 9

In the table I also give, for comparison, the dates in the Greek and Roman calendars (p. 20).

There is no question that on or about the above days festivals were anciently celebrated in these islands, possibly not all at all holy places, but some at one and some at another; this, perhaps, may help to explain the variation in the local traditions and even some of the groupings of orientations.

The earliest information on this point comes from Ireland.

Cormac, Archbishop of Cashel in the tenth century, states, according to Vallancey, that "in his time four

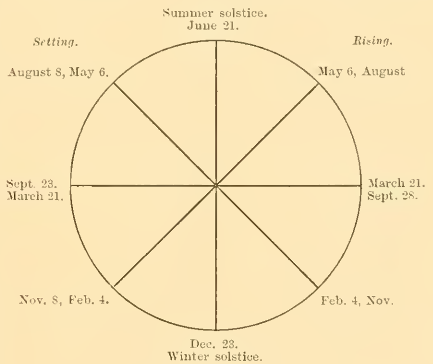


FIG. 23.—The farmers' and astronomical years.

great fires were lighted up on the four great festivals of the Druids, viz., in February, May, August, and November."[1]

I am not aware of any such general statement as early as this in relation to the four festivals of the May year in any part of Britain, but in spite of its absence the fact is undoubted that festivals were held, and many various forms of celebration used, during those months.

From the introduction of Christianity attempts of different kinds were made to destroy this ancient time system and to abolish the so-called "pagan" worships and practices connected with it. Efforts were made to change the date and so obliterate gradually the old traditions; another way, and this turned out to be the more efficacious, was to change the venue of the festival, so to speak, in favour of some Christian celebration or saint's day. The old festivals took no

[1] Continued from vol. lxxii. p. 272.

[1] Hazlitt, "Dictionary of Faiths and Folklore," under Gule of August.

account of week-days, so it was ruled that the festivals were to take place on the first day of the week; later on some of them were ruled to begin on the first day of the month.

When Easter became a movable feast, the efforts of the priests were greatly facilitated, and indeed it would seem as if this result of such a change was not absent from the minds of those who favoured it.

The change of style was, as I have before stated, a fruitful source of confusion, and this was still further complicated by another difficulty. Piers[1] tells us that consequent upon the change "the Roman Catholics light their fires by the new style, as the correction originated from a pope; and for that very same reason the Protestants adhere to the old."

I will refer to each of the festivals and their changes of date.

February 4.

Before the movable Easter the February festival had been transformed into Ash Wednesday (February 4). The eve of the festival was Shrove Tuesday, and it is quite possible that the ashes used by the priests on Wednesday were connected with the bonfires of the previous night.

It would seem that initially the festival, with its accompanying bonfire, was transferred to the first Sunday in Lent, February 8.

I quote the following from Hazlitt[2]:—

"Durandus, in his 'Rationale,' tells us, Lent was counted to begin on that which is now the first Sunday in Lent, and to end on Easter Eve; which time, saith he, containing forty-two days, if you take out of them the six Sundays (on which it was counted not lawful at any time of the year to fast), then there will remain only thirty-six days: and, therefore, that the number of days which Christ fasted might be perfected, Pope Gregory added to Lent four days of the week beforegoing, viz. that which we now call Ash Wednesday, and the three days following it. So that we see the first observation of Lent began from a superstitious, unwarrantable, and indeed profane, conceit of imitating Our Saviour's miraculous abstinence. Lent is so called from the time of the year wherein it is observed: Lent in the Saxon language signifying Spring."

Whether this be the origin of the lenten fast or not it is certain that the connection thus established between an old pagan feast and a new Christian one is very ingenious: 24 days in February plus 22 days in March (March 22 being originally the fixed date for Easter) gives us 46 days $(6\times7)+4$, and from the point of view of priestcraft the result was eminently satisfactory, for thousands of people still light fires on Shrove Tuesday or on the first Sunday of Lent, whether those days occur in February or March. They are under the impression that they are doing homage to a church festival, and the pagan origin is entirely forgotten not only by them but even by those who chronicle the practices as "Lent customs."[3]

Finally, after the introduction of the movable Easter, the priests at Rome, instead of using the "pagan" ashes produced on the eve of the first Sunday in Lent or Ash Wednesday in each year, utilised those derived from the burning of the palms used on Palm Sunday of the year before.

Further steps were taken to conceal from future generations the origin of the "pagan" custom due on February 4. February 3 was dedicated to St. "Blaze." How well this answered is shown by the following quotation from Percy.[4] "The anniversary of St. Blazeus is the 3rd February, when it is still the custom in many parts of England to light up fires on the hills on St. Blayse night: *a custom antiently taken up perhaps for no better reason than the jingling resemblance of his name to the word Blaze.*"

This even did not suffice. A great candle church festival was established on February 2. This was called "Candlemas," and Candlemas is still the common name of the beginning of the Scotch legal year. In the Cathedral of Durham when Cosens was bishop he "busied himself from two of the clocke in the afternoone till foure, in climbing long ladders to stick up wax candles in the said Cathedral Church; the number of all the candles burnt that evening was 220, besides 16 torches; 60 of those burning tapers and torches standing upon and near the high altar."[1]

There is evidence that the pagan fires at other times of the year were also gradually replaced by candles in the churches.

May 6.

The May festival has been treated by the Church in the same way as the February one. With Easter fixed on March 22, 46 days after Easter brought us to a Thursday (May 7), hence Holy Thursday[2] and Ascension Day. With Easter movable there of course was more confusion. Whit Sunday, the Feast of Pentecost, was only nine days after Holy Thursday, and it occurred, in some years, on the same day of the month as Ascension Day in others. In Scotland the festival now is ascribed to Whit Sunday.

It is possibly in consequence of this that the festival before even the change of style was held on the 1st of the month.

In Cornwall, where the celebrations still survive, the day chosen is May 8.

August 8.

For the migrations of the dates of the "pagan" festival in the beginning of August from the 1st to the 12th, migrations complicated by the old and new style, I refer to Prof. Rhys' Hibbert lectures, p. 418. in which work a full account of the former practices in Ireland and Wales is given.

The old festival in Ireland was associated with Lug, a form of sun-god. The most celebrated one was held at Tailltin. This feast—Lugnassad—was changed into the Church celebration Lammas—from A. S. hláfmaesse—that is loaf-mass, or bread-mass, so named as a mass or feast of thanksgiving for the first fruits of the corn harvest. The old customs in Wales and the Isle of Man included the ascent of hills in the early morning, but so far I have come across no record of fires in connection with this date.

November 8.

The fact that November 11 is quarter day in Scotland, that mayors are elected on or about that date, shows, I think, clearly that we are here dealing with the old "pagan" date.

The fact that the Church anticipated it by the feast of All Souls' on November 1 reminds us of what happened in the case of the February celebration, later I give a reference to the change of date; and perhaps this change was also determined by the natural gravitation to the first of the month as in the case of May, and because it marked at one time the beginning of the Celtic year.

[1] "Survey of the South of Ireland," p. 232.
[2] Under Ash Wednesday.
[3] Frazer, "Golden Bough," ii., 247 *et seq.*
[4] "Notes to Northumberland Household Book," 1770, p. 333.

[1] Quoted by Hazlitt.
[2] Much confusion has arisen with regard to the Holy Thursday in Rogation week because there is another Holy or Maundy Thursday in Easter week. Archæologists have also been often misled by the practice of many writers of describing the May festivals as midsummer festivals. The first of May, of course, marked the *beginning* of summer.

But what seems quite certain is that the feast which should have been held on November 8 on astronomical grounds was first converted by the Church into the feast of St. Martin on November 11. The "Encyclopædia Britannica" tells us

"The feast of St. Martin (Martinmas) took the place of an old pagan festival, and inherited some of its usages (such as the Martinsmännchen, Martinsfeuer, Martinshorn, and the like, in various parts of Germany."

St. Martin lived about A.D. 300. As the number of saints increased, it became impossible to dedicate a feast-day to each. Hence it was found expedient to have an annual aggregate commemoration of such as had not special days for themselves. So a church festival "All Hallows," or "Hallowmass," was instituted about A.D. 610 in memory of the martyrs, and it was to take place on May 1. For some reason or another this was changed in A.D. 834. May was given up, and the date fixed on November 1. This was a commemoration of all the saints, so we get the new name "All Saints' Day."

There can be little doubt that the intention of the Church was to anticipate and therefore gradually to obliterate the pagan festival still held at Martinmas, and it has been successful in many places, in Ireland, for instance; at Samhain,[1] November 1 "the proper time for prophecy and the unveiling of mysteries; . . . it was then that fire was lighted at a place called after Mog Ruith's daughter Tlachtga. From Tlachtga all the hearths in Ireland are said to have been annually supplied, just as the Lemnians had once a year to put their fires out and light them anew from that brought in the sacred ship from Delos. The habit of celebrating *Nos Galan-galaf* in Wales by lighting bonfires on the hills is possibly not yet quite extinct."

Here, then, we find the pagan fires transferred from the 8th to the 1st of November in Ireland, but in the Isle of Man this is not so. I will anticipate another reference to Rhys by stating that Martinmas had progressed from the 11th to the 24th before the change of style had brought it back, "old Martinmas," November 24, being one of the best recognised "old English holidays," "old Candlemas" being another, at the other end of the May year, which had slipped from February 2 to February 15 before it was put back again.

With regard to the Isle of Man Rhys writes[2] that the feast is there called Hollantide, and is kept on November 12, a reckoning which he states "is according to the old style." The question is, are we not dealing here with the Martinmas festival *not* antedated to November 1? He adds, "that is the day when the tenure of land terminates, and when serving men go to their places. In other words it is the beginning of a new year." This is exactly what happens in Scotland, and the day is still called Martinmas.

There is a custom in mid-England which strikingly reminds us of the importance of Martinmas in relation to old tenures, if even the custom does not carry us still farther back. This is the curious and interesting ceremony of collecting the wroth silver, due and payable to his Grace the Duke of Buccleuch and Queensbury, on "Martinmas Eve." The payment is made on an ancient mound on the summit of Knightlow Hill, about five miles out of Coventry, and in the parish of Ryton-on-Dunsmore. One feature about this singular ceremonial is that it must be observed before sun-rising. The money is now paid as a sort of highway rate for the privilege of using certain roads in the Hundred of Knightlow, and, according to the ancient charter, the penalty is a fine of twenty shillings for every penny not forthcoming, or the forfeiture of a white bull with red nose and ears. There are no defaulters nowadays, and if there were it would certainly be difficult, if not impossible, to find a beast answering the above description, as this breed of cattle has become extinct. When the short ceremony is over, those taking part adjourn to a wayside inn, and there with glasses charged with hot rum and milk they toast the Duke's health.

NORMAN LOCKYER.

[1] Rhys, "Hibbert Lectures," p. 514.
[2] "Celtic Folklore," p. 315.

AN AUSTRALIAN STORY BOOK.[1]

SHOULD any reader of NATURE desire to give a Christmas present to a boy or girl he might do much worse than buy Mrs. Jeanie Gunn's little book, but before parting with it he should himself look through it. The author has a great sense of humour, and seizes on salient features of native life and describes them in a few words; these gifts, combined with a real sympathy with the blackfellow, have enabled her to write a little book that is full of human interest. This is not an ethnographical treatise, and no matters are gone into in detail, yet the reader will learn somewhat of the life of Australian aborigines and of their relations with the white man, and if he should not acquire any deep knowledge he will have nothing to unlearn, and that is something to be thankful for.

A few examples culled at random will give a good idea of this most excellent little book.

"The blacks' sign language is very perfect. They have a sign for every bird, beast, fish, person, place and action. They have long talks without uttering a word. There are many times when a blackfellow must not speak, unless by signs. For instance, if he is mourning for a near relative, or has just come from a very special corrobboree. Often he must keep silent for weeks, and occasionally for months, and it is because of this and many other reasons that the sign language is so perfect. Everyone can speak it, and everyone does so when hiding in the bush from enemies, and then there is no fear of voices being heard."

"It is very wonderful, but then the blacks *are* wonderful. To have any idea of how wonderful they are, you must live among them, going in and out of their camps, and having every one of them for a friend. Just living in a house that happens to be in a blackfellow's country is not living among blacks, although some people think it is."

"I had plenty of Eau de Cologne, and used it freely. One day when Bett-Bett smelt it, as I was sprinkling it over my dress, she screwed up her little black nose, and after half-a-dozen very audible sniffs, said—'My word, Missus! That one goodfellow stink all right!'"

"Anyone can 'sing magic,' even lubras, but of course the wise old magic men do it best. It never fails with them, particularly if they 'sing' and point one of the special Death-bones or Sacred stones of the tribe. Generally a blackfellow goes away quite by himself when he is 'singing magic,' but very occasionally a few men join together, as they did in the case of Goggle Eye. . . . Of course the man who has been 'sung' must be told somehow, or he will not get a fright and die. There are many ways

[1] "The Little Black Princess: A True Tale of Life in the Never-never Land." By Jeanie Gunn. Pp. vii+107; illustrated. (London: The De La More Press, 1905.) Price 5s. net.

of telling him, without letting him know who has 'sung' him; but the man who leaves the bone about must, of course, be very careful to destroy his own tracks. Have you ever heard of faith-healing? Well, dying from bone-pointing is faith-dying! Goggle Eye, after he had found the bones lying about, knew exactly what was going to happen to him—and of course it did."

"You cannot change a blackfellow into a white man, if you try; you only make a bad, cunning, sly old blackfellow. I don't mean you can't make a blackfellow into a better blackfellow. I know that can be done, if he is kept a blackfellow, true to his blackfellow instincts." A. C. H.

FIG. 1.—Tree-burial, south of the Roper River. From "The Little Black Princess."

NOTES.

THE Nobel prizes in science have this year been awarded as follows: The prize for physics to Prof. P. Lenard, of the University of Kiel, for his investigations on kathode rays; the prize for chemistry to Prof. Adolf von Bayer, of the University of Munich, for the development in organic chemistry and chemical industry resulting from his works on organic colouring matters and hydro-aromatic compounds; the medical prize to Dr. Robert Koch, for his discoveries in connection with tuberculosis. The prizes, consisting of a sum of about 7700*l*., an illuminated diploma, and a gold medal with an appropriate inscription, were presented by King Oscar on December 10 at the annual ceremony in commemoration of the founder of the institution.

THE following note appeared in the *Times* of December 7:—Sir William Thiselton-Dyer, whose resignation of the post of director of the Royal Botanic Gardens at Kew is announced, has held that appointment since 1885, and for ten years—1875–1885—before his promotion he was assistant director. His successor, Lieut.-Colonel David Prain, had a distinguished university career at Aberdeen and Edinburgh before he entered the Indian Medical Service in 1884. Three years after his arrival in India he was nominated curator of Calcutta Herbarium; in 1895 he became professor of botany at the Medical College, Calcutta, and superintendent of the Royal Botanic Garden there, and in 1898 he was appointed director of the Botanical Survey of India. He is forty-eight years of age.

THE German Anatomical Society has decided to erect a memorial of its honorary president, the late Prof. Albert von Kölliker. The memerial will be erected in Würzburg, with which the famous teacher and investigator was intimately associated.

PROF. E. RIECKE, professor of experimental physics and applied electricity in the University of Göttingen, and also director of the Physical Institute, celebrated his sixtieth birthday on December 1; whilst Prof. R. Fittig, emeritus professor of chemistry of the University of Strassburg, celebrated his seventieth birthday on December 6.

THE committee appointed to carry the proposal of a memorial to the late Prof. Virchow into execution has now, we learn from the *British Medical Journal*, a sum of 4000*l*. at its disposal. Of this amount, 1800*l*. has been contributed by subscribers and 2200*l*. by the city of Berlin. Three prizes, of the value respectively of 150*l*., 100*l*., and 50*l*., are offered for the best design of a memorial. Drawings must be sent in before April, 1906.

THERE is a movement on foot in German chemical and technical circles to erect a statue in Freiburg, Saxony, to the memory of the late Prof. Dr. Clemens Winkler, who was professor in the Royal Mining Academy at Freiburg, and died in Dresden last year. The proposed memorial is to take the form of a large block of granite decorated with a medallion picture of the deceased investigator and a short account of his life's work.

THE French Académie des Inscriptions et Belles Lettres has elected Dr. Arthur Evans, keeper of the Ashmolean Museum, and Mr. Barclay, head keeper of the department of coins and medals in the British Museum, corresponding members of the academy.

THE thirteenth meeting of the International Congress of Prehistoric Anthropology and Archæology will be held at Monaco, under the patronage of Prince Albert the First, on April 16–21, 1906. Particulars as to the congress may be obtained from the general secretary, Dr. Verneau, 61 Rue de Buffon, Paris.

AT a meeting of the British committee for the Marseilles International Exhibition of Oceanography and Sea

Fisheries held last Friday, a central committee was nominated, consisting of Sir John Murray, K.C.B., the honorary president, Captain D. Wilson-Barker, Mr. W. E. Archer, Dr. H. O. Forbes, Mr. E. W. L. Holt, Dr. H. R. Mill, Dr. P. C. Mitchell, Prof. D'Arcy W. Thompson, C.B., Mr. J. W. Towse, and Dr. G. H. Fowler as honorary secretary.

A CONFERENCE on smoke abatement and an exhibition of smoke-preventive appliances, arranged by the Royal Sanitary Institute and the Coal-Smoke Abatement Society, were opened at the large hall of the Horticultural Society on Tuesday. At the conference parts of an address by Sir Oliver Lodge, who was prevented by illness from being present, were read by Sir William Richmond; and at the conclusion of the reading a paper entitled "Is London Fog Inevitable?" was contributed by Dr. W. N. Shaw.

THE dinner of the Institute of Chemistry was held on Monday at the Hotel Metropole, the president, Mr. David Howard, being in the chair. Responding to the toast of the institute, the president said that they had a very high ideal when they founded the institute; they wished to raise the standard of the chemist to something like the same level as that of the other learned professions. The position of the professional chemist was higher in England than it was anywhere else, and why? Because there was that independence of thought, that individual excellence and individual devotion to duty which was required in a true professional spirit.

THE seventeenth annual dinner of the Institution of Electrical Engineers took place on December 8 at the Hotel Cecil. A distinguished gathering assembled. Short speeches, in proposing and responding to the various toasts, were delivered by Mr. Babington Smith, the president (Mr. John Gavey), Sir Alexander Kennedy, F.R.S., Mr. E. Cunliffe Owen, Mr. Alexander Siemens, Mr. John G. Maydon, Mr. W. M. Mordey, Sir Alexander Binnie, and Dr. Budde, president of the Verband Deutscher Elektrotechniker of Berlin. Dr. Budde remarked that, speaking on behalf of his fellow electricians in Germany, he gratefully acknowledged the thought and the spirit expressed in the invitation to himself to be their representative as guest of the institution. Contact, he said, between the scientific and technical men of all countries cannot be too close. There are matters enough tending to separate nations, and therefore it cannot be too strongly pressed that research and intellectual labour form a tie which will always draw together the best spirits of the world, and must tend to promote international solidarity.

ON Saturday, December 9, a very interesting ceremony took place at the Royal Forest Hotel, Chingford, when a presentation was made to Mr. Wm. Cole, the founder of the Essex Field Club, in honour of the completion of his twenty-five years of service as hon. secretary, editor of the publications, and curator of the two museums founded by the club. At the instigation of the president, Mr. Miller Christy, a "recognition fund" was started a few months ago with Prof. Meldola as chairman, Mr. David Howard as treasurer, Mr. Christy as secretary, and a committee. The invitations issued on behalf of the movement were most cordially responded to, and the fund asked for was exceeded long before the subscription list was closed. At the dinner at Chingford Prof. Meldola presided and made the presentation on behalf of the subscribers, Mr. Cole and his brothers and sisters, all of whom had cooperated with him in carrying out the work of the club during the whole period of its existence, being present as the guests of the evening. The presentation took the form of an illuminated address and a purse. Among those who were present to support the chairman, and who bore testimony to the value of the work of the club and of the services of the hon. secretary and his family, were Mr. Victor Buxton, the High Sheriff of Essex, Mr. Christy and Mr. David Howard, the president and treasurer of the club, Mr. T. V. Holmes and Prof. Boulger, past-presidents, Mr. Gellatly, representing the verderers of Epping Forest, Messrs. W. Whitaker and Horace B. Woodward, hon. members of the club, Mr. W. M. Webb, representing the Selborne Society, and others. A very large number of appreciatory letters had also been sent, and were read from the chair, among the writers being the Countess of Warwick, Lord Rayleigh, Sir John Evans, Mr. E. N. Buxton, Profs. Ray Lankester, Marshall Ward, E. B. Poulton, and J. B. Farmer, Dr. Horace Brown, Mr. F. W. Rudler, Dr. J. C. Thresh, the chairman of the Essex County Council, the chairman of the Epping Forest committee, and all the past-presidents of the club other than those who were present. After the reading and presentation of the address by the chairman, and the handing of the purse by the treasurer, Mr. Cole returned thanks on behalf of himself and family. In the course of his remarks he laid emphasis on the services which the chairman of the evening had specially rendered to the club as their first and eighth president, and who had ever taken the keenest interest in their work. He produced a copy of the original inaugural address delivered by Prof. Meldola in 1880, and pointed out that the general policy of the club had been sketched out therein, and that it, with subsequent addresses, had been to them as models laying down the lines on which the work of their own and of all kindred societies ought to be conducted. In concluding, Mr. Cole also directed attention to several branches of work which he hoped to see the club take up in the future, among these being the establishment of a marine biological station, and the preservation, in connection with the photographic survey, of Essex folklore and dialects by means of phonographic records.

AT a meeting of the Institution of Civil Engineers on December 5, the Hon. Charles A. Parsons, C.B., F.R.S., and Mr. G. G. Stoney, in a paper read before the institution, traced the evolution of the steam-turbine from the time of Hero of Alexandria, following the chief steps in development that have led to the types in present use. After describing and discussing the chief characteristics of the three types of steam-turbine, which practically cover the whole field of useful turbine inventions, viz. the Parsons turbine, introduced in 1884, the De Laval turbine in 1888, and the Curtis turbine in 1902, the development of the Parsons turbine was dealt with. A good vacuum is required for the economical working of steam-turbines, and certain special conditions and arrangements must be observed in order to obtain a vacuum of $27\frac{1}{2}$ inches to 28 inches. An apparatus called a vacuum-augmenter has been designed by the authors, and consists of a steam jet placed in a contracted pipe between the condenser and the air-pump. With this apparatus, a total net reduction of steam-consumption of about 8 per cent. at full load has been obtained. Experience gained from cross-Channel steamers and yachts shows that the propellers of turbine vessels do not race in a heavy seaway, that the vessels maintain their smooth-water speed to a remarkable extent in heavy seaway, and that they start, stop, and manœuvre promptly.

IN a recent issue of *Scientific Investigations* (*Irish Fisheries*), 1904, Prof. G. H. Carpenter describes the

Pycnogonida, or sea-spiders, of the Irish seas, naming two new representatives of the group, each of which is figured.

"VOLITION IN MICRO-ORGANISMS" is the translation of the title of a paper by Mr. R. B. Mesén, published at San José, Costa Rica, apparently as the first part of a serial entitled *Publicaciones Nuevas por Contribucion de Amigos*. While admitting that the activity of such organisms is automatic, and due in the first instance to external stimulants, the author considers that such "automatomism" constitutes the basis of the human will, and that there is a complete gradation from the former to the very highest developments of the latter.

PERHAPS the most generally interesting article in the November number of the *American Naturalist* is one in which Mr. F. B. Loomis attributes the phenomenon in animals commonly known as "over specialisation" to "momentum." As examples of structures coming under the designation of over specialisation, the author cites the tusks of the sabre-toothed tigers, the radiolarian shell, the sutures of ammonites, sponge-spicules, and the horns of wild sheep, wapiti, and elk. A variation started in one particular line tends, in the author's opinion, to develop in that one direction; if the feature be harmful the development dies, otherwise it may continue *ad infinitum*. This theory of momentum, it is added, has not been credited with the importance to which it is entitled. Whether we are very much more forward for this supposed explanation of a very obvious feature in development may perhaps be open to doubt.

FROM the entomological division of the U.S. Department of Agriculture we have received a copy of a catalogue of exhibits of economic entomology at the recent St. Louis Exhibition, forming Bulletin No. 47. The whole exhibit was intended to bring into prominence the general scope of the work of the entomological division. Intimately connected with this is a memoir on the Mexican cotton-boll weevil, by Messrs. Hunter and Hinds, forming Bulletin No. 45 of the entomological division of the U.S. Agricultural Department. This weevil (*Anthonomus grandis*) has the evil distinction of having developed during the last twenty years from an insignificant into a notorious insect. In 1885 it was ascertained for the first time that this weevil attacked cotton in Mexico, and between that date and 1902 it crossed the Rio Grande into Texas, where it has since spread with extraordinary rapidity, and inflicted enormous losses on cotton-growers. After spreading for the first few years very quickly, it was checked for a time by unfavourable seasons, but meeting with suitable conditions in 1898 it soon colonised the greater part of the State. It was hoped that in ten years' time Texas would double its output of more than ten million bales of cotton, but this is now regarded as impossible.

IN the course of an article on western explorations for fossil vertebrates, published in the October number of the *Popular Science Monthly*, Prof. H. F. Osborn states that "it is an extremely slow and difficult matter to prepare a fossil, however carefully collected, for exhibition. It takes two years or more to work out the collections of a single season; the result is that most of our museums are collecting materials more rapidly than they can be worked. . . . With larger endowments or with special gifts these treasures could be more rapidly brought to light." It will not fail to be noticed that public exhibition of these wondrous fossils, when properly mounted, is regarded by American museum officials as a matter of prime importance. Those who pay for these institutions do not like the treasures hidden away for the sole benefit of the student.

A CHARACTERISTIC of modern American museums is formed by the restored models of extinct animals, of which there are scarcely any in the corresponding institutions of this country. A considerable number of such models were used by Prof. Osborn to illustrate his discourse on progress in mammalian palæontology during the last decade in America, delivered before the International Zoological Congress at Berne last year. The report of this lecture, published in the *Comptes rendus* of the congress, contains photographs of these models, one of the most spirited of which is herewith reproduced. In this instance, the restoration has been a comparatively easy task, as the animal belongs to an existing genus, but the workers under the author's direction have not hesitated to attempt to reproduce the external form of the Tertiary titanotheres and uintatheres, and even of the giant reptiles of the Jurassic and Cretaceous. It may be hoped that we shall ere long see some of these excellent restorations in our own museums. The author points out that there are three fossil elephants in America, viz. the mammoth (*Elephas primigenius*) in the far north, *E. columbi* (akin to *E. antiquus*) chiefly in the central States, and *E. imperator* (allied to *E. meridionalis*) in the south. Taken as a whole, Prof. Osborn's record of progress is little short of marvellous, and ought to make European palæontologists jealous, if jealousy could be supposed to exist in matters scientific.

FIG. 1.—Model of an Extinct Elephant (*Elephas imperator*).

THE report by Dr. Ashburton Thompson on the fourth outbreak of plague at Sydney in 1904 adduces further evidence on the part played by rats in the communication of plague to man. During the three last plague epidemics in this city, an epizootic among the rats was always found to precede the epidemic in man.

THE *Bulletin of the Johns Hopkins Hospital* for November (xvi., No. 176) contains the first of the Herter lectures on the contributions of pharmacology to physiology by Prof. Hans Meyer, the second part of the paper by Mr. Martin on the cause of the heart beat, and articles of considerable anatomical and medical interest.

THE October number of *Naturen*, published at the Museum, Bergen, contains an article by Prof. L. Kny on the sensitivity of plants, and a historical summary of the researches on the nature of alcoholic fermentation written by Mr. P. R. Sollied.

The American gooseberry mildew, *Sphaerotheca mors-uvae*, which was reported from Ireland in 1900, and from Russia in the succeeding year, has also appeared in Sweden. Dr. J. Eriksson, writing in Bulletin No. 87 of the experimental station of the Royal Agricultural College, traces the disease that developed in Karlshamm, in the south of Sweden, to bushes that had been imported from Denmark.

The monthly journal *Tropical Life* deals chiefly with tropical agriculture and commerce. Reference is made in the November number to two American machines recently brought out, the one a sugar-cane harvester, the other an auto-cottonpicker. The latter machine is provided with two long mechanical arms moving lightly in a universal joint; along each arm runs an endless belt studded with hooks. The arms are tilted to come in contact with the bolls, when the hooks pull away the whole mass, and the cotton passes along the belt to a receptacle. The possibility of utilising banana stems and trash for the manufacture of paper is discussed in view of the large amount of material that is produced in the cultivation of the fruit.

The cultivation of tomatoes under glass, with special reference to the value of pruning, is discussed in Bulletin No. 105 issued from the Hatch Experimental Station of the Massachusetts Agricultural College. The writer, Mr. G. E. Stone, advocates planting in beds rather than in pots, although the root restriction in pots favours early maturity. Pruning is said to promote early ripening and to produce increased size of fruit. There is some difference of opinion whether it is better to prune to one or three stems, but there is a general consensus in favour of cutting out the leader.

The report of the chief of the United States Weather Bureau for the fiscal year 1903–4 (pp. xxxix+381) contains, in addition to tables of observations and summaries at some 1650 stations, an interesting account of the very useful operations of that organisation. Weather forecasts for thirty-six and forty-eight hours in advance are issued for each State, besides special warnings of gales, cold waves, floods, &c. To mention one case only of the utility of the storm warnings—a hurricane which advanced from the West Indies destroyed property to the value of 100,000 dollars during its progress over Florida, but, owing to timely notice, comparatively little damage was done to vessels, as they remained in port in consequence of the warnings. Prof. W. L. Moore reiterates the hope that the time will come when it will be possible to forecast the weather for coming seasons, but that time has not yet arrived, and the officials of the Weather Bureau have been instructed to warn the public against imposition by long-range forecasters. A course of lectures on meteorology has been delivered by Prof. Abbe to students frequenting the Bureau, and we understand that this useful practice is now being carried out at our own Meteorological Office. The lectures present the results of work done by some of the ablest meteorologists in various parts of the world, and undoubtedly tend to excite greater interest in the science generally.

In the *Transactions of the American Mathematical Society* for October Mr. F. R. Sharpe discusses the stability of motion of viscous liquids. It was found by Reynolds in 1895 that for a liquid of density ρ and viscosity μ moving between two planes at distance $2b$ apart, the motion was unstable when $2b\rho U/\mu > 517$, while for a cylindrical pipe of radius a the critical velocity was given by $2ba/\mu = 1034$. Mr. Sharpe now obtains for the first case the constant 167 instead of 517, and for the second 470 instead of 1034.

In the *Smithsonian Miscellaneous Collections*, vol. xlvii., Prof. E. W. Scripture gives a first report of his studies on the construction of a vowel organ. The first experiments were made with reeds, but it was soon found necessary to replace these by rubber membranes held in various frames, and representing more closely the action of the human glottis. It is now possible to imitate all the vowels and their variations, and the remaining problem is to replace the rubber glottis by something that changes its form of vibration for different vowels and does not alter with time. When this can be done it will be possible to construct either a complete organ or a vowel register such as could be effectively used in church music. A register of one octave would require 124 vowel pipes.

In a note contributed to the *Journal of the Royal Microscopical Society* (first read before the New York Microscopical Society in April last) Mr. Daniel D. Jackson advances the view that the movements of diatoms are caused by the evolution of gas. This idea was first suggested to the author by noticing the behaviour of a lithia tablet in a glass of water: The bubbles of carbonic acid gas given off set up the exact motions in the tablet that have been so often described for the movements of diatoms —"a sudden advance in a straight line, a little hesitation, then other rectilinear movements, and, after a short pause, a return upon nearly the same path by similar movements." Mr. Jackson next made small models of diatoms of aluminium, 2 mm. thick, having longitudinal grooves resembling those of the diatoms. When placed in caustic soda these models not only reproduced the actual movements of the diatoms, but also gave rise to currents in the matter closely resembling those described by Prof. H. L. Smith as the result of observations made by placing indigo in the water.

We have received the *Transactions of the English Ceramic Society*, including the papers and discussions for the season 1904–5. It is satisfactory to note that the president, in the course of his address, considered that the scorn for technical instruction affected by pottery manufacturers in the past appeared to be dying out. Allusion was also made to the steps taken by the Joint Committee of Manufacturers of Staffordshire to foster research in pottery by offering prizes for original work bearing on certain subjects. The society appears to be in a prosperous condition, and its efforts are becoming more and more appreciated both at home and abroad. Amongst the various papers we notice an interesting contribution by the pottery instructor, Dr. J. W. Mellor, on crystallisation in pottery.

In No. 7 of the Bulletin of the Royal Academy of Belgium Prof. W. Spring describes experiments extending his well known work on the colour of natural waters. He comes to the conclusion that the calcium compounds present in natural waters have no colour peculiar to themselves, and hence are not responsible for the green tint of many waters containing them. This is probably due to the diffraction produced by minute solid particles, the presence of which can be demonstrated by an intensely luminous ray of light. Calcium salts really tend to conserve the pure blue colour of water by causing the elimination of ferric salts and humic materials. When a highly calcareous water is of a greenish hue it generally indicates that there is an equilibrium between the influx of brownish water containing humic material and ferric salts, and the purifying action of the calcium salts. In No. 8 of the same Bulletin Prof. Louis Henry discusses in a theoretical paper the properties of water and their relation to the formula H_2O. The physical properties point to a polymerisation of

the molecule, whilst a consideration of the chemical properties leads to the conclusion that the two atoms of hydrogen are functionally different, and that in reality water has a disymmetric formula.

A VERY interesting paper by M. T. Godlewski on certain radio-active properties of uranium is contained in No. 5 of the *Bulletin International* of the Cracow Academy of Sciences. A re-investigation has been made of the anomalous phenomena encountered by Meyer and Schweidler in studying the activity of uranium X. These authors had concluded that the decay curve of uranium X is not complementary to the recovery curve of uranium, but M. Godlewski considers that this only holds when the uranium nitrate containing the UrX is separated from its solution by crystallisation; when it is separated by evaporation to dryness at a temperature sufficiently high to remove the water of crystallisation, an abnormally high rate of decay is not observed. In fractionally crystallising uranium nitrate, uranium X, which is easily soluble in water, accumulates in the mother liquors; several crystallisations will completely deprive uranium nitrate of UrX. The author explains the increase of activity observed in the crystallisation of uranium nitrate as being due to an accumulation of UrX in the upper surfaces of the crystals; this appears to be confirmed by the observation that the activity of a crystal when turned over was found to be only one-third of the activity measured from the upper side. Experiments are brought forward to show that the first rapid decay of activity after crystallisation, which causes an uneven distribution of UrX throughout the plate, is due to the diffusion of UrX from the upper layers of the crystal, where it is more concentrated, to the lower, where the concentration is smaller. The view is held that the uranium X is dissolved in the crystals and the total mass of uranium in the form of a solid solution.

A SECOND and revised edition of the section of the report issued by the Engineering Standards Committee dealing with standard locomotives for Indian Railways has been published by Messrs. Crosby Lockwood and Son at 10*s*. 6*d*. net.

WE have received from Messrs. John J. Griffin and Sons, Ltd., a copy of their "H" list dealing with apparatus for use in the teaching of hydrostatics and pneumatics. The excellence of the illustrations and the lucidity of the brief descriptions make the catalogue a very serviceable one.

A CIRCULAR from the bio-chemical department of the University of Liverpool announces that the first number of a new periodical—the *Bio-Chemical Journal*—will be issued in January. Contributions are invited, dealing with all portions of the subject of bio-chemistry in its widest sense. The journal will be issued monthly, in so far as material is available.

THE University of Chicago Press has published a second edition of Dr. C. J. Chamberlain's "Methods in Plant Histology." The first edition of the book was reviewed in our issue for November 28, 1901 (vol. lxv. p. 75). The new issue contains both alterations and additions; and some of the improvements suggested in the review referred to have been made.

IN noticing the illustrated catalogues of makers of scientific apparatus in this country from time to time, we have directed attention to the excellence of the illustrations accompanying the descriptions of the different instruments. A revised price-list of microscopes and accessories which has been received from the Bausch and Lomb Optical Co., Rochester, N.Y., is another instance of a carefully arranged and admirably illustrated catalogue. The catalogue provides information concerning microscopes made by this firm suitable for general laboratory work, advanced work, bacteriology, photomicrography, and a physician's needs. The necessary accessories are detailed fully, and clear descriptions make their special characteristics easily understood. The sole representatives of the company in this country and the colonies are Messrs. A. E. Staley and Co., 19 Thavies Inn, Holborn Circus, E.C.

OUR ASTRONOMICAL COLUMN.

ANOTHER NEW COMET, 1905*c*.—A telegram from the Kiel Centralstelle announces the discovery of a new comet, by Prof. Giacobini, of the Nice Observatory, on December 6·080.

At 16h. 53·7m. (Nice M.T.) the comet's position was

$$R.A. = 14h.\ 21m.\ 39{\cdot}4s.,\ dec. = +20^\circ\ 59'\ 29'',$$

and subsequent observations showed that its daily movement in R.A. amounted to $+1^\circ\ 08'$ ($= +4m.\ 32s.$) and in dec. to $-0^\circ\ 26'$.

From the above it is seen that, when discovered, the comet was about 10m. east and $1^\circ\ 15'$ north of Arcturus, and that it is apparently travelling slowly towards the constellation Serpens.

A second telegram from Kiel announces that the comet was observed at the Lick Observatory on December 8. The position at 17h. 16·5m. (Lick M.T.) was determined as $R.A. = 14h.\ 32m.\ 58s.$, $dec. = +19^\circ\ 55'\ 36''$.

Circular No. 82 from Kiel states that the following elements and ephemeris have been computed by Mr. Morgan (Glasgow, Mo.) from observations made on December 6, 7, and 8, and communicated to the Centralstelle by Prof. E. C. Pickering:—

Elements.

T = 1906 January 16·20 (G.M.T.).

$$\left.\begin{array}{l} \omega = 213^\circ\ 56' \\ \Omega = \ \ 93\ \ 21 \\ i = \ \ 44\ \ 23 \end{array}\right\} 1905{\cdot}0$$

$$q = 0{\cdot}0928$$

Ephemeris 12h. G.M.T.

1905		α h. m. s.		δ ° ′		Brightness
Dec. 14	...	15 1 28	...	+17 1		
18	...	15 24 56	...	+14 22		
22	...	15 50 48	...	+11 13	...	4·22

The computed brightness for December 10 was 1·66, the brightness at time of discovery being taken as 1·0.

COMET 1905*b*.—A number of observations of comet 1905*b* (Schaer's) are recorded in No. 4057 of the *Astronomische Nachrichten*.

Using the Bruce telescope, and exposing for fifty-five minutes, Prof. Wolf photographed the comet on November 21, and obtained an image which showed the object to be unsymmetrical. A fine, faint tail was seen to issue from the coma in a position angle of 92°, reckoning from the direction of the comet's path. This tail was curved, with the concave side preceding, and at a distance of 22′ from the nucleus it was broken, the second part having a slightly different direction to the first.

On November 20 Prof. Wolf was able to see the comet with the naked eye, and estimated its magnitude to be about 5·5. On November 21 he found it to be about 6·3m., and on November 24 observed that it had decreased to 7·0.

The ephemeris calculated by Herr M. Ebell gives the position of this comet on December 15 as

$$\alpha = 23h.\ 32m.\ 16s.,\ \delta = -10^\circ\ 30'{\cdot}5,$$

and its brightness as about 0·04 of that at the time of discovery.

ORBITAL ELEMENTS OF TWO METEORS.—From a number of observations of a meteor which was seen on August 3 Dr. P. Moschick, of Heidelberg, has calculated the radiant point, the earth point, the velocity, and the height of the meteor, and also the elements of its orbit. For the apparent radiant he obtained $\alpha = 317° 56'$, $\delta = -11° 54'$, and for the mean velocity 47.93 ± 8.37 km. per second, the probable value for the absolute velocity being 52·74 km. per sec. The elements show the orbit to be hyperbolic, and the meteor's motion in the orbit to be direct.

A second meteor was seen by numerous German observers on September 28, and Dr. Moschick has treated the observational results similarly. For the position of the radiant point he obtained $\alpha = 354° 54'$, $\delta = +22° 40'$, and therefore concluded that the object observed was a Pegasid. The relative and absolute velocities were respectively 21·51 and 36·4 km. per second, and the calculated elements show that the meteor moved, with a direct motion, in an elliptical orbit (*Astronomische Nachrichten*, No. 4057).

MAGNETIC DISTURBANCE DURING THE RECENT AURORAL DISPLAY.—In a paper communicated to the Paris Academy of Sciences, M. Th. Moureaux states that a strong magnetic disturbance took place about 9 o'clock on November 15, coinciding, in point of time, with the exceptionally fine auroral display which was so generally observed. From 8h. 59m. to 9h. 9m. (Paris M.T.) the declination, which was already below the normal, diminished by 34′, and then quickly recovered, increasing 42′ between 9h. 9m. and 9h. 24m. The horizontal and vertical components were simultaneously affected in the opposite direction. Similar disturbances took place on November 12. Numerous small groups of sun-spots were on the solar disc during this period, and the first large group seen in October, now much scattered and diminished, was due to cross the central meridian on the evening of November 13, during its second rotation (*Comptes rendus*, No. 21).

THE ZODIACAL LIGHT TO THE NORTH OF THE SUN.—Whilst in Switzerland recently, Prof. Newcomb ascended the Brienzer Rothorn in order to observe, if possible, the extension of the zodiacal light in the north and south direction. He found that the light was bright enough to be seen at a distance of 35° from the sun in the direction of the solar axis, and he assumes that it extends equally on both sides. Prof. Newcomb therefore suggests that the zodiacal light shall in future be described "as a luminosity surrounding the Sun on all sides, of which the boundary is nowhere less than 35° from the Sun, and which is greatly elongated in the direction of the ecliptic" (*Astrophysical Journal*, No. 3, vol. xxii.).

CANADIAN ELECTRIC POWER STATIONS AT NIAGARA.

ON January 2 of this year, in the power house of the Canadian Niagara Power Company, on the Canadian side at Niagara, the largest units used in the development of water-power were started. This great power house is situated in Victoria Park, and all the work of development is done under consent from the Government of the Province of Ontario and the commissioners of the park.

Fourteen years ago ground was broken on the New York side at Niagara for a power development by means of a wheel-pit and tunnel. The 105,000 horse-power thus developed has been a great inspiration to the growth of the American city, and Canadians looked forward to the time when they should profit by a similar development. Now their hopes are being realised, for three strong companies are actively at work on the Canadian side developing power from the water that speeds toward the Horseshoe or Canadian Fall. It was in 1892 that the Canadian Niagara Power Company secured its first rights to develop power in Canada, and since then it has paid the park commissioners more than 225,000 dollars in the retention of its privileges, while its first horse-power was developed on the date above mentioned.

The Canadian Niagara Power Company is allied to the Niagara Falls Power Company of the New York side of the river, but in its Canadian development it has given men of science and electrical engineers the most wonderful installation to study yet known in the field of any water power development. In the big power houses on the New York side the unit of development is 5000 horse-power, but on the Canadian side the unit is 10,000 horse-power. It was in 1890, at a meeting of the International Niagara Commission, held in London, that a unit of 5000 horse-power was adopted for the development on the American side at Niagara.

Ten years have elapsed since Rudolph Baumann, a Swiss engineer, turned the wheel that started the first 5000 unit on April 4, 1895, and since that day the installation has been doubled in size and output capacity, and is in every way a success. Now comes Canadian Niagara with its units of 10,000 horse-power, the largest in the world. Mr. William H. Beatty, of Toronto, Ontario, who is president of the Canadian Niagara Power Company, turned the small wheel that controls the flow of water from the penstocks to the turbines, and as he admitted the flood of water the monster generator began to revolve, and within a few minutes was making 250 revolutions a minute, the speed at which it is to be steadily operated. Unit No. 2 was also started, making 20,000 horse-power available in the

FIG. 1.—Site of the Power House of the Ontario Power Co., showing its nearness to the Horseshoe Fall.

station, and by May 1 three additional units of the same size were ready to run, giving off a total of 50,000 horse-power from the five machines. In all, eleven units will be installed in this station, so that its final output will be 110,000 horse-power, or 5000 horse-power more than is available from the twenty-one machines in the two power houses of the Niagara Falls Power Company on the American side of the river.

In the wheel-pit and tunnel method of developing power at Niagara, a great slot, several hundred feet long, is excavated in the earth to a depth of about 180 feet and 21 feet wide. From the bottom of the wheel-pit a tail race or tunnel is driven through solid rock a distance of 2200 feet to the lower river or gorge. This tunnel is built in the form of a horseshoe, and is about 20 feet wide by 25 feet high. It is lined from end to end with vitrified brick and concrete, while the wheel-pit is also carefully lined. From the upper river a canal of short length diverts water from the main stream to a forebay at one side of the big power house. Near the bottom of the wheel-pit the turbines are installed, and these are connected to the generators in the power station over the wheel-pit by vertical shafts or tubes. From the forebay to the turbines penstocks 10 feet in diameter run to the turbines, and as

the gates are raised the water pours from these penstocks into the wheels that give motion and life to the big generators. As the water passes through, or is discharged from, the turbines, it falls into the tunnel, and then flows through this tail race to the lower river and gorge. It is diverted from the main stream but a very few minutes, but in that time it serves to aid man in gaining control of thousands of electrical horse-power.

It is agreed between the power companies and the commissioners of Victoria Park that all power generated in the park limits must be transmitted outside the park boundaries for application and use, and so the electric current from the station referred to will pass to a transformer station not far distant, where, for transmission purposes, it will have its voltage raised to 40,000 or 60,000 volts, in order that it may successfully and economically be sent to Toronto and other distant places to meet the demand for electric power from Niagara. Toronto has long been anxious to be connected by a transmission line with the power development at the falls, and now a line for transmission purposes has been about completed, so that electric current from the generators in the station of the Canadian Niagara Power Company may be used in the

FIG. 2.—Power House of Canadian Niagara Power Co., being erected over the wheel-pit.

operation of the trolley cars and lighting systems of the Canadian city nearly 90 miles away from Niagara.

The Electrical Development Company of Ontario, Ltd., is also constructing a wheel-pit and tunnel power development in Victoria Park. The works of this company will be a short distance above the site of the development of the Canadian Niagara Power Company, but, for all this, the tunnel it is building will be slightly shorter than the tunnel of the company last named, because it will run right under the river-bed, over which the upper rapids toss, to a point behind the falling sheet of water of the Horseshoe Fall, where it will empty into the lower river. From the bottom of this wheel-pit there will be two short lateral tunnels that will carry the water from the pit to the main tunnel at a point 165 feet from the bottom of the slot. This company projects a development of about 125,000 horse-power, and the machinery it will instal will command general attention.

The Ontario Power Company is another concern that has secured a franchise for the development of power in Victoria Park. Its method of development will be quite different from that of the other two companies referred to. Its power house, a concrete and iron structure, has been built at the water's edge, in the gorge, a short distance below the Horseshoe Fall, and water will be carried to it by penstocks concealed from view in tunnels that have been driven through the rocky bank from a spillway or open relief on top of the bank. From this spillway great steel flumes will extend to the forebays, which are situated far up the river. There will be three of these steel flumes, each 18 feet in diameter and more than 6000 feet long. Each will divert 3900 cubic feet of water every second, which is an amount estimated to be sufficient to develop 60,000 electrical horse-power in the station at the water's edge. Thus from the three steel flumes and the water supply thus afforded, no less than 180,000 horse-power is to be developed. This power will pass from the generators to a transformer station located on the bluff in the rear of Victoria Park more than 250 feet above the power house, and more than 550 feet back from it.

ORRIN. E. DUNLAP.

INVESTIGATION OF THE UPPER AIR.

THE subjoined announcement has been received from the director of the Meteorological Office.

In response to representations from various quarters, the Meteorological Committee has assigned from the Parliamentary grant under its control a sum for promoting the investigation of the upper air by kites and other means.

The immediate objects in view are:—(1) To establish an experimental station where kite ascents and other experimental investigations can be carried out, especially on the days selected for international cooperation. (2) To develop and extend the instrumental equipment, so that facilities may be afforded for the cooperation of other observers upon sea or land. (3) To provide for the publication of the observations in combination with those of other countries, by a contribution to the cost of the international publication undertaken by the president of the International Commission for Scientific Aërostation, Prof. H. Hergesell, of Strassburg.

Mr. W. H. Dines, F.R.S., has undertaken the direction of the operations for the Meteorological Office. His experiments for the office are carried on at his house at Oxshott.

An endeavour will be made, with fair prospect of success, to enlist the cooperation of marine observers in correspondence with the office. Captain A. Simpson, of the S.S. *Moravian*, has already expressed his willingness to make a trial of this method of extending our knowledge of marine meteorology as soon as the necessary gear and instruments can be supplied.

It is hoped that through the assistance of others who are interested in such investigations, and have at their disposal the means of carrying them out, an effective scheme for the investigation of the upper air may be set on foot. Lieut.-Colonel J. E. Capper, C.B., R.E., of the Aldershot Balloon Companies, has already facilities for such purposes, and will take part; Mr. G. C. Simpson, lecturer in meteorology in the University of Manchester, is making arrangements for occasional observations on the Derbyshire hills; Mr. C. J. P. Cave, who has already made some interesting kite ascents in Barbados, has provided himself with the necessary equipment for experiments at Ditcham Park; and Mr. S. H. R. Salmon has arranged a station on the Downs near Brighton, and carries out ascents on the international days.

There is, accordingly, a prospect of an effective investigation being commenced.

BOTANY AT THE BRITISH ASSOCIATION.

THE president, Mr. Harold Wager, F.R.S., dealt in his address, which was delivered at Johannesburg, with some problems of cell structure and physiology. The text of this address has already appeared (September 21) in NATURE.

As was to be expected, there were fewer papers than usual this year in Section K, and of these relatively few were of a purely technical nature, the majority being either general accounts of recent work or else papers which possessed some special local interest.

General Papers.—Prof. R. W. Phillips opened the pro-

ceedings at Cape Town by delivering a semi-popular lecture on recent advances in our knowledge of seaweeds. Dealing first with the attached shore vegetation, the lecturer pointed out that, with the exception of a very few phanerogams, this consists entirely of blue-green, green, red, and brown algæ. In the red algæ the most important recent work is that of Oltmanns, who has shown, in opposition to the view maintained by Schmitz, that no real nuclear fusion takes place in the auxiliary cells. In the brown algæ Williams's work on the Dictyotaceæ has considerably modified the views previously held regarding them. Not only has he discovered motile antherozoids in this group, but his work on their cytology points to the existence of a definite alternation of generations. Farmer and Williams had shown that in the Fucaceæ the reduction of chromosomes takes place at the origin of the oogonium. In Dictyota, however, as originally shown by Mottier, and since confirmed by Williams, the reduction division occurs in the mother-cells of the tetraspores. There would thus appear to be in this plant two generations, precisely similar in their external morphology, but fundamentally distinct in respect of the number of chromosomes in the dividing nucleus. Our knowledge of the floating oceanic vegetation has been greatly extended by the members of the German plankton expedition, and other workers. The lecturer dealt with the distribution of this floating vegetation in the surface waters of the globe, and described some of the adaptations which prevent rapid sinking of the minute forms composing it.

Mr. R. P. Gregory discussed some of the problems of heredity. He first gave a general account of Mendel's principles of heredity, referring to some of the more recent work on Mendelian lines. He then dealt particularly with some new experiments conducted by Mr. Bateson and himself, on the inheritance of heterostyly in Primula. Although certain irregularities were observed, on the whole the characters of long and short style were inherited in the usual Mendelian ratio, the short style being dominant, the long recessive. Further experiments, conducted in the hope of throwing light on the fact, observed by Darwin, of the relative infertility in "illegitimate" as compared with "legitimate" crosses in Primula, were inconclusive.

Prof. F. E. Weiss contributed a paper on the value of botanical photographs. He pointed out that the mapping of the plant-associations of any given district, and the detailed study of the ecological factors concerned, can be most usefully supplemented by good photographs showing the general aspect and distribution of the vegetation. It is important to have, not only general photographs of various plant-associations, but also photographs of the different members of such associations. Plant photography can also be usefully employed in morphological, pathological, and other studies. The truth of the author's remarks was forcibly illustrated by a series of beautiful lantern slides. Two committees are now at work collecting botanical photographs and rendering them available for teaching and other purposes. One, recently established for the survey of British vegetation, is concerning itself with British ecological photographs; the other, the British Association committee for the registration of photographs of botanical interest, has adopted a wider scheme, and is anxious to receive help from scientific photographers in all parts of the world.

An interesting discussion took place on educational methods in the teaching of botany. The president (Mr. Harold Wager, F.R.S.), who opened the discussion, was of opinion that the methods usually employed, both in universities and schools, neither develop real interest in the subject nor afford an adequate training in scientific method. He emphasised the importance of basing all courses of botanical teaching on practical work, both observational and experimental, such work to be carried out by the students themselves. Lectures should be rather of the nature of discussions upon the facts learned during practical work than merely informational. A good deal of faulty educational method is due to the domination of examinations. It is almost impossible for satisfactory work to be done if teachers are compelled to follow set syllabuses, which are generally so extensive as to leave little room for originality on the part of the teacher.

Several speakers agreed with the general conclusions of the president, but Mr. A. C. Seward, F.R.S., and Prof. Douglas Campbell were inclined to lay more stress on the importance of lectures, particularly where advanced students are concerned.

Miss Lilian Clarke contributed to the discussion a most interesting account of her methods of teaching botany in the James Allen School for Girls at Dulwich. She gives no set lectures, but the girls make observations and conduct experiments, not only in the school garden, where each girl has charge of a plot, but also in the laboratory. The latter has been designed so as to admit as much light as possible; it can also be kept at a constant temperature, so that practical work on living plants can be carried on at all seasons of the year.

South African Botany.—Mr. A. C. Seward, F.R.S., in discussing the fossil floras of South Africa, gave a general account of the plants characteristic of the Lower Karroo, Stormberg, and Uitenhage series. He laid stress on the need for further field work, as more material, particularly petrified specimens for microscopical examination, is badly needed to render our knowledge of these floras more complete.

Prof. A. Engler and Dr. R. Marloth presented important papers on the floras of tropical Africa and South Africa respectively.

Prof. Engler dealt with his subject largely from the ecological point of view. Discussing first the meteorological conditions of tropical Africa, he pointed out that in every tropical country, where the altitude of the land surface varies from sea-level to high mountains, practically the same plant-formations can be distinguished, though, of course, their systematic composition may be very different in different cases. The author then enumerated the various halophilous, hygrophilous, xerophilous and other formations, with their subdivisions, finally discussing the affinities of the flora as a whole. The dominant element of the flora is one peculiar to tropical Africa, the plants composing which are more nearly related to those of India and Madagascar than they are to those of tropical America. But besides this native element, we find in tropical Africa other elements. Thus in the hygrophilous formations of East Africa, Indian and Madagascan elements abound, while in those of West Africa a distinct tropical American element is found. A South African element is present, particularly in the shrub-formations of Angola and East Africa; a Mediterranean element in the north-east, especially in Somaliland; and lastly, in the high mountains, many species belonging to a boreal element are found. From the entire absence on these mountains of many groups characteristic of northern regions, Prof. Engler concludes that such northern forms as are here found have entered by immigration, and are not the remnants of a once widely spread Old World flora.

The botanical regions proposed by Dr. Marloth in his paper on the phyto-geographical subdivisions of South Africa are somewhat similar to those suggested by Bolus, Engler, and others, though differing in detail. The two main divisions, very unequal in size, are A, the Cape province, characterised by many endemic plants of more or less south temperate affinities, and B, the palæo-tropical province. The latter is again subdivided, according to ecological conditions and floral constituents, into (1) the grass-steppe regions, including the Bush-veld, High-veld, Kalahari, and the Caffrarian countries; (2) the central districts of Cape Colony, including the Karroo, the Karroid plateau and Little Namaqualand; (3) the western littoral; (4) the forests of the south coast; (5) the south-eastern coast belt.

Mr. J. Burtt-Davy contributed a paper on the climate and life zones of the Transvaal. He divides the Transvaal, according to altitude and climate, into three zones, which he terms the High, Middle, and Low Veld respectively. Each is characterised, not only by its native vegetation, but also by the crops it is capable of producing.

Mr. F. B. Parkinson gave an interesting account of irrigation farming as carried on at the Orange River farm at Baviaankrantz. To raise the water, chain and bucket pumps are employed, working in shafts sunk at a sufficient distance from the river to be above flood-level. The shafts are supplied with water from the river by means of 10-inch syphons. By judicious watering, winter cereal crops, and

summer crops of potatoes, peas, &c., can be profitably grown.

Mr. T. R. Sim discussed the distribution of South African ferns, and pointed out that the recent opening up of the Orange River Colony, the Transvaal, and Rhodesia has resulted in the filling up of many gaps in our knowledge of this subject.

Dr. Schönland gave a survey of our knowledge of South African succulent plants, chiefly from the historical and systematic points of view.

A paper was also contributed by Mr. J. Medley Wood on the indigenous plants of Natal.

Technical Papers.—Among these may be mentioned an interesting note by Dr. Horace T. Brown, F.R.S., on the dissipation of absorbed solar radiation by xerophilous plants. He pointed out that in ordinary foliage leaves the amount of heat necessary to vaporise the water of transpiration is so considerable that such a leaf may be subjected to intense solar radiation without acquiring a temperature of more than a very few degrees above that of the surrounding air. In xerophilous plants, however, transpiration is at a minimum, and therefore some other method of guarding against the risk of dangerously high temperatures is necessary. According to the author, this is to be found in the loss of heat due to thermal emission. Experiments have been conducted by him (in collaboration with Dr. W. E. Wilson) which show that a powerful cooling effect is produced by the high thermal emissivity of a leaf surface, even when transpiration is completely in abeyance.

Prof. H. H. W. Pearson communicated an interesting account of his investigations into the development and germination of the spores of Welwitschia. The results obtained show that some of the current views of the relationship of this extraordinary plant to the other genera of the Gnetaceæ must be considerably modified.

Prof. Douglas Campbell described the prothallium and reproductive organs of *Gleichenia pectinata*, and directed attention to the similarity that exists between them and those of Osmunda.

Prof. M. C. Potter presented two papers. In the first an account was given of some experiments which showed that amorphous carbon can be slowly decomposed by the agency of a soil bacterium, with the evolution of carbon dioxide.

The second dealt with the healing of parenchymatous tissues in plants. According to the author, the first step in this process (prior to the formation of cork) is the closing of the intercellular spaces by the formation of a "wound-gum" similar to that described by Temme in wounded xylem vessels. Thus the increased rate of gaseous interchange caused by the wound is very soon checked.

Mr. I. B. P. Evans, in a paper on infection phenomena in the Uredineæ, said that it is quite possible to identify different species of Puccinia by the shape of their infection vesicles.

Dr. G. Potts contributed a paper on the action of calcium compounds on *Plasmodiophora Brassicae* ("finger and toe"). Experiments show that an acid soil encourages the growth of the parasite, while alkaline substances inhibit it.

A most interesting feature of the Cape Town meeting was afforded by a fine collection of native plants, brought together with considerable trouble by Dr. Marloth. These included a number of the more striking succulents from the Karroo region, and also a great many plants from the south-west district of Cape Colony. The latter were, for the most part, in flower, the heaths and the Iridaceæ in particular presenting a beautiful blaze of colour. Dr. Marloth also exhibited a number of ecological photographs taken in various parts of Cape Colony.

But, apart from the meetings themselves, the over-sea botanists found considerable opportunities of observing the vegetation of the various districts passed through during the tour. It is true that much of the travelling was hurried, but even when passing rapidly through a new country a botanist is able to gather valuable impressions of the general facies, &c., of the vegetation.

At the Cape, though the season was still early spring, a considerable number of plants were in flower. Table Mountain and the slopes of the Lion's Head were explored so far as time permitted, and many plants characteristic of the Cape Peninsula flora were observed. Some of the most striking of these were plants belonging to the families Ericaceæ, Proteaceæ, and Restiaceæ.

Several members of Section K visited the Karroo, and spent some days in examining the many curious xerophilous desert plants to be found there.

In the Transvaal and elsewhere little or no rain had fallen for some five months before the visit of the association, and in consequence the country presented a very parched and brown appearance, except where irrigation had resulted in vivid patches of green crops, or groves of Eucalyptus trees had been planted. The latter, as well as other Australian plants, have been extensively imported, and promise to become of considerable economic importance in South Africa.

A very striking feature of the bush vegetation in various parts of the Transvaal was the extraordinary prevalence of parasitic Loranthaceæ, many of the acacia and other trees being loaded with the parasites.

At Pretoria the Government experimental grounds were visited, the visitors being received by Mr. Smith, the Director of Agriculture, and Mr. Burtt-Davy. Extensive experiments are being at present carried on here with a view to the introduction of new grasses to improve the pasturage of the Transvaal. Other useful introduced plants include several species of Atriplex (the Australian "saltbush"). As these plants are markedly xerophilous, and at the same time good fodder plants, they will probably prove very useful in a climate such as that of the Transvaal.

The agricultural department in Pretoria had also arranged an exhibition illustrative of the vegetable products of the Transvaal.

Mr. Burtt-Davy arranged a special botanical excursion to the Magaliesberg, where the "Wonderboom," an exceedingly fine specimen of *Ficus cordata*, was visited.

Other areas of botanical interest passed through included the High Veld, the Bush Veld, the teak forest of Rhodesia, and the luxuriant so-called rain-forest immediately surrounding the Victoria Falls.

PRIZE SUBJECTS OF THE INDUSTRIAL SOCIETY OF MULHOUSE.

THE Industrial Society of Mulhouse has issued its programme of the prizes to be awarded by the society during the year 1906; excluding the subjects which are of a purely local or technical character, the following are the principal prizes open to competition to all nations.

In the section of chemistry medals of honour are offered for a memoir on the theory and manufacture of alizarin-red by the rapid process, for a synthesis of the colouring matter of cochineal, for a research on cochineal carmine, for an investigation of the colouring matter of cotton, of the transformation of cotton into oxycellulose, or of the composition of aniline blacks; also for a research on the chemical changes of wool under the action of hypochlorites or chlorine, for a synthesis of a natural dye, for a theory of the manner of formation in nature of any organic substance, or for a chemical study of the fat of Turkey-red. Several medals will also be awarded for special chemical studies of mordants and their action, for the production by artificial means of certain dyes, and for practical methods of fixing certain dyes to the fibre. A method of manufacturing carbon tetrachloride at a price such as will enable it to compete with carbon bisulphide and benzene is also required. A sum of 500 francs to 1000 francs will be allotted to the best compilation of the densities of inorganic and organic substances in the solid state and in cold saturated solution. Medals will be given for the production of substances capable of taking the place of certain named chemicals which have an industrial use, and for the solution of a number of specified problems in the bleaching, dyeing, and printing of textiles.

In the section of mechanical arts a prize of 500 francs with a silver medal is offered for a new method of construction of buildings suitable for cotton spinning, wool combing, or calico printing. The following subjects will receive medals:—a new type of steam boiler; an indicator of the total work done in a steam engine; new forms of

gas generators for gas engines; new types of gas engines; a new method of heating boilers; new methods of spinning, weaving, and dyeing textile fabrics; a simple cut-out for electrical installations.

The following subjects in natural history and agriculture will be awarded medals:—a geological or mineralogical description of part of Alsace; a detailed catalogue of plants in the neighbourhood of Mulhouse, Thann, Altkirch, and Guebwiller; a treatise on the fauna of Alsace; a treatise on the plants and insects inimical to agriculture in Alsace and the methods of destroying them.

In commerce and statistics the prize subjects are:—a study of methods of insurance against risks of transport; a treatise on insurance against fire, with especial reference to the factories of Alsace; a memoir on the variation in the price of coal in Alsace during the last thirty years; a study of the effect of taxation on industrial development.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has announced to the Senate the munificent gift of 1750*l*., made by Dr. Ludwig Mond towards the fund for increasing the stipends of the Stokes and Cayley university lecturers in mathematics.

The detailed proposals put for the diploma in forestry were to be discussed on Thursday last. Apparently they satisfied the members of the university, for there was no criticism made on them.

The degree of Master of Arts, *honoris causa*, is to be conferred upon Mr. R. I. Lynch, curator of the botanic garden. Mr. Lynch is well known as a writer on horticultural subjects.

On the nomination of the board of geographical studies, Dr. Guillemard and Sir G. D. T. Goldie, K.C.M.G., F.R.S., and on the nomination of the council of the Royal Geographical Society, Sir Clements R. Markham, K.C.B., F.R.S., and Dr. J. Scott Keltie, have been appointed members of the board of geographical studies for the year beginning January 1, 1906.

Mr. J. B. Peace has been appointed chairman of the examiners for the mechanical sciences tripos, 1906.

The general board of studies has approved Mr. H. J. H. Fenton, of Christ's College, for the degree of Doctor in Science.

The following notice of the next award of the Walsingham medal has been issued:—The medal is to be awarded for a monograph or essay giving evidence of original research on any botanical, geological, or zoological subject. The competition is open to graduates of the university who at the time fixed for sending in the essays are under the standing of Master of Arts. The essays for the ensuing year are to be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums) not later than October 10, 1906.

The special board for biology and geology give notice that the Gedge prize will be offered for competition in the Michaelmas term, 1906. The prize will be awarded for the best original observations in physiology, but a candidate who has received a certificate of research from the university will not be entitled to submit an essay which is substantially the same as the dissertation for which such certificate of research was granted. Candidates need not necessarily be graduates of the university. Essays are to be sent to the professor of physiology not later than October 1, 1906.

DR. A. J. EWART, special lecturer in vegetable physiology, Birmingham University, has been appointed professor of botany in the University of Melbourne in succession to the late Baron von Müller.

THE will of the late Mr. John Edward Taylor, part proprietor and a former editor of the *Manchester Guardian*, on which probate was granted in London on December 9, among numerous bequests, leaves, on the decease of the widow, 20,000*l*. to the Victoria University of Manchester.

AT a meeting of the council of the University of Birmingham held on December 6, the Chancellor announced that the family of the late Mr. Harding had offered 10,000*l*. to the Birmingham University for the erection of a library. The offer has been gratefully accepted by the council.

ON Tuesday, December 5, Sir W. Martin Conway distributed the prizes and certificates gained by the students at the Sir John Cass Technical Institute during the past session. Sir Owen Roberts, chairman of the governing body, presided. Mr. George Baker stated that the scope of the work of the institute and the number of students continued to progress steadily, and that a large proportion were studying subjects bearing directly upon the industries in which they were engaged. Sir Martin Conway, in the course of his address, pointed out that people in this country suffer from a confusion of ideas in respect to education, and that they do not believe sufficiently in the necessity of giving the highest possible education to the directing brains of industries, nor do they understand sufficiently the length of time and the experience that are required for skilful hands to receive their full equipment. He remarked that the real struggle with Germany in manufactures is due to the enormous number of highly educated men turned out at the German universities; it is not a question of technical education, but of scientific education. The German is not a whit more scientific or better than the Briton, but faith in science which exists in Germany is lacking in England, and this gives the Teutonic tortoise the advantage over the British hare.

THE following bequests and gifts for higher education in the United States are announced in *Science*. By the will of the late Mr. Stephen Salisbury, the Worcester Polytechnic Institute receives a bequest of 40,000*l*. This money comes without restrictions of any kind on the part of the testator. In addition to this bequest, Mr. Salisbury, at the time of his resignation a few weeks ago from the presidency of the board of trustees, made an additional gift to the institute of 20,000*l*., to be paid immediately. Formal announcement of the 50,000*l*. legacy to the Sheffield Scientific School from the estate of the late Mr. M. D. Viets has been made by Prof. Russell H. Chittenden, director of the school. The bequest will be used for the physical, mathematical, and general scientific needs of the school. The late Mr. Frank Harvey Cilley, the engineer, has bequeathed the residue of his estate, which will probably amount to 14,000*l*., to the Massachusetts Institute of Technology. Mr. T. P. Shonts, chairman of the Isthmian Canal Commission, has given to Monmouth College 2000*l*. as part of the 6000*l*. needed to obtain an additional 6000*l*. which Mr. Andrew Carnegie had promised to give the college for a library. The late Mr. Stephen Salisbury, of Worcester, Mass., has bequeathed 40,000*l*. to the Worcester Polytechnic Institute, 50,000*l*. to the American Antiquarian Society, and 1000*l*. and a site for a building for the Worcester Natural History Society.

PROF. W. J. ASHLEY, dean of the faculty of commerce in the University of Birmingham, distributed on December 6 the prizes gained by candidates at the examinations of the London Chamber of Commerce. During the course of a subsequent address, Prof. Ashley remarked that the science of commerce has yet to be made, but, in his opinion, a true science of commerce is capable of being created. At present, however, it does not exist. Its formulation should have been the task of the political economists; but hitherto English economists have been too content to pursue the results, the conclusions to be reached by a process of reasoning starting with certain assumptions. It is necessary that the problems which actually present themselves to a business man in the course of his operations should be realised and studied, and that the various ways in which they have been approached and faced ought to be brought together, grouped, criticised, and analysed. The function of the economist is not to arrive at general abstract conclusions and then look round in the world of business for examples or illustrations of the conclusions arrived at. He should condescend to a more concrete and a more patient survey of the actual facts of real life. Prof. Ashley considers it to be vitally important that the highest type of education shall be brought into close touch with the realities of economic life. If that is properly done it will not degrade education, but vivify it.

THE current number of the *Monthly Review* contains an article on public school education by Mr. A. C. Benson, in which some valuable testimony as to the inadequacy as a training for life of a purely classical education is given. The question as to what are the intellectual accomplishments of a boy of average intelligence who has been through a public school and a university is answered in the following words:—"He knows a very little Latin and Greek, and he endeavours to put them out of his mind as fast as he can; he knows a little science; perhaps a little history, mostly ancient. He cannot generally calculate correctly in arithmetic; he knows no modern languages to speak of; he cannot express himself in simple English, and his handwriting is often useless for commercial purposes." And later, we read, "he has learnt to think the processes of the mind dreary and unprofitable, to despise knowledge, to think intellectual things priggish and tiresome." Mr. Benson summarises his contentions in the following words:—"believing intensely, as I do, in the possibilities of intellectual education, I have tried to judge the classical system as fairly as I can by results, and I see that those results are in many cases so unsatisfactory and so negative that experiments are urgently needed. Simplification seems to me to be the one essential thing." If a writer who was formerly a master at our greatest public school finds it necessary to write in this plain manner, it is evidently high time that scientific methods were applied to obtain an answer to the question, what constitutes a suitable public school education, and how can it be secured?

A LARGE audience assembled at the Borough Polytechnic Institute on Monday evening, December 4, on the occasion of the thirteenth annual meeting and distribution of prizes and certificates. The chairman, Mr. Leonard Spicer, said the work of the institute was going forward with great strides, and he feared that, even allowing for the additions to the building which had recently been made, the governors would again be faced with the problem of knowing how to house the students. Although the word "polytechnic" is still associated in many minds with recreation and amusements, the chief work of institutes of this kind lies in an educational and technical direction, 15,000*l.* a year being the least sum upon which the work at the Borough can be carried on at present. Mr. C. T. Millis, the principal, read the annual report, which disclosed a very satisfactory state of progress of the institute. An experiment is being made in the direction of coordination with London County Council evening schools, and several new classes have been started. A satisfactory feature of the work of the institute is the readiness with which intending students ask for and follow advice given as to their courses of study, and the increasing number of students who attend for two, three, and four years. After the certificates, which numbered considerably more than five hundred, and the numerous prizes were distributed by Lady Lockyer, Sir Norman Lockyer, K.C.B., delivered an address. In a few remarks, Prof. Perry claimed for the polytechnic institutions of London that they were doing a work that was unprecedented, and which our colonies are now endeavouring to imitate. He had recently returned from South Africa, where he found the people following the lead which London was now giving in the matter of technical education. Votes of thanks were proposed and seconded by Sir Philip Magnus and Mr. W. F. Sheppard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Electrical Conductivity of Dilute Solutions of Sulphuric Acid." By W. C. D. **Whetham**, F.R.S.

The equivalent conductivity of neutral salts when dissolved in water approaches a limiting value as the dilution is increased; with solutions of acids and alkalies, however, the equivalent conductivity reaches a maximum, and then falls rapidly as the dilution is pushed farther.

It has been supposed that this diminution of equivalent conductivity at extreme dilutions is due to interaction between the solute and the impurities which remain even in re-distilled water.

Kohlrausch has given evidence to show that the chief impurity in water carefully re-distilled is carbonic acid, and Goodwin and Haskell conclude that the diminution of equivalent conductivity of dilute acids is due to the presence of carbon dioxide.

In order to examine the real effect of carbonic acid and other impurities on the conductivity of an acid solution, the writer and his wife have carried out an investigation in which the amount of impurity was varied, and the result observed. The conductivity of dilute solutions of sulphuric acid and its variation with concentration was determined in four solvents:—(1) good quality re-distilled water; (2) the same water to which a trace of carbon dioxide had been added; (3) the same water with a trace of potassium chloride; (4) the same water which had been freed as far as possible from carbonic acid and other volatile impurities by repeated boiling under diminished pressure.

In each case the conductivity of the solvent was subtracted from that of the solution. The results may be summarised as follows:—

Within the limits of experimental error, the equivalent conductivity of a dilute acid is not affected by boiling the water under diminished pressure, though the conductivity of the solvent is thereby much diminished. The equivalent conductivity of the acid is also unaffected by the addition of a small quantity of potassium chloride to the water, though the conductivity of the solvent is thereby much increased. But, by the addition of a little carbonic acid, the equivalent conductivity of the sulphuric acid is diminished appreciably. It is natural to conclude that, while the presence of carbonic acid would produce a diminution of equivalent conductivity of the same character as that observed, it does not explain the total effect.

"The Accurate Measurement of Ionic Velocities." By Dr. R. B. **Denison** and Dr. B. D. **Steele**. Communicated by Sir William Ramsay, K.C.B., F.R.S.

The authors have succeeded in devising an apparatus with which it is possible to compare and measure the velocities of the ions of a given salt without using gelatin or other membrane during the actual experiment. This enables the method of direct measurement of ionic velocities to be extended to dilute solutions, and the results obtained are free from any error due to electric endosmose.

The transport number and the average absolute velocity of the ions of a number of salts have been measured at dilutions down to one-fiftieth normal, and at two temperatures, 18° C. and 25° C. It is easy to measure by this method the transport number of the ions of some salts which present great difficulty by the analytical method of Hittorf, *e.g.* $KClO_3$, $KClO_4$, $KBrO_3$. The following are some of the numbers obtained for the anion transport number:—$KCl\ n/10$, 0·508; $NaCl\ n/10$, 0·618; $KCl\ n/50$, 0·507; $CaCl_2\ n/50$, 0·587. The corresponding numbers determined by the analytical method are 0·508, 0·617, 0·507, 0·59.

The values obtained by the authors for the average velocity of the ions in cm./sec. agree in a remarkable manner with those calculated by Kohlrausch from conductivity data, and form a striking confirmation of the ionic theory of solutions. The values of the ionic velocity of the potassium ion in KCl, KBr, and KI are, for example, found to be:—at $n/10$, 0·000563, 0·000562, 0·000564 cm./sec.; at $n/50$, 0·000606, 0·000598, 0·000599 cm./sec. at 18° C.

It is claimed that the method is at least as accurate as that of Hittorf, and an experiment can be performed in about one-tenth of the time. It also gives a means of comparing the degree of dissociation of salts containing a common ion.

Mineralogical Society, November 14.—Prof. H. A. Miers, F.R.S., president, in the chair.—The determination of the angle between the optic axes of a crystal in parallel polarised light: Dr. J. W. **Evans**. The crystal plate is rotated on the optic normal as axis, and the positions are determined in which the relative retardation is nil. This may be observed by using a gypsum plate or the double quartz wedge devised by the author. In the latter case the positions in question are marked by the coincidence of the bands in the two halves of the wedge. This gives a very exact reading if strictly parallel light be employed.—Mineralogical notes (diopside and albite): Prof. W. J. **Lewis**. A large tabular crystal of white diopside, a brown

diopside of unusual habit, and a Carlsbad twin of albite were described.—Note on the crystallisation of drops, especially of potash-alum: J. **Chevalier.** The president described observations made by Mr. Chevalier on the crystallisation of drops of solution of potash-alum. These generally yield in succession (*a*) birefringent spherulites; (*b*) octahedra; and (*c*) a fine rectangular network. (*a*) is probably a less hydrated alum, and it becomes isotropic on exposure to moist air by conversion into (*b*). (*c*) is ordinary alum which is in a state of strain, owing to its rapid crystallisation, and becomes white and opaque after a time owing to the development of cracks. Drops observed upon a slide under the microscope behave differently according as they are in the metastable or labile condition. A metastable drop inoculated with (*a*), (*b*), or (*c*) deposits octahedra. A labile drop inoculated with (*a*) deposits spherulites, but inoculated with (*b*) or (*c*) deposits the rectangular network. When a metastable drop containing either octahedra or spherulites, or both, passes into the labile condition (by cooling or by evaporation), they may continue to grow unchanged. If, however, a fragment or germ of octahedral alum be introduced into a labile drop the network (*c*) is immediately produced. An alum crystal growing in a labile solution is surrounded by a zone of metastable liquid which prevents it from starting the network (*c*) characteristic of a labile drop. Experiments were made upon the action of various mineral substances in inducing crystallisation in metastable and labile drops. Among these the holosymmetric cubic crystals, and especially galena, exercise a remarkable effect in producing the network (*c*) in labile drops.—Note on the formation of gypsum crystals in a disused well at chemical works: C. J. **Woodward.** Groups of gypsum crystals were exhibited which were found thirty years ago studding the walls of an old well at Messrs. Chance's chemical works at Oldbury.—Notes on minerals recently found in the Binnenthal: R. H. **Solly.** The minerals described were (1) Ilmenite, in brilliant crystals, displaying marked hemihedrism and showing five new forms. It is associated with quartz, adularia, magnetite and mica, on mica schist. (2) Seligmannite; an exceptionally large and well developed crystal in dolomite. Unlike any previously described, it is untwinned; altogether forty-five forms were observed, of which twenty-one are new. (3) Marrite; two more crystals of this rare mineral were found, one tabular and the other sharply pointed in habit. (4) Proustite; a minute crystal deposited on a crystal of rathite. (5) Trechmannite; a crystal of this rare mineral displaying asymmetric hemihedrism, deposited on a crystal of binnite. (6) Hyalophane; in crystals of an unusual green colour.

Entomological Society, November 15.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—A flower-frequenting beetle from the Transvaal, illustrating a remarkable device for the cross-fertilisation of flowers, one of the front feet being tightly clasped by the curiously formed pollinia of an Asclepias: Mr. **Arrow.**—A remarkable specimen of *Agrotis tritici*, taken this year at Oxshott, bearing a close resemblance to *A. agathina*, with which it was flying over heather: W. J. **Kaye.** The specimen was a good example of syncryptic resemblance brought about by the common habit of resting on heather.—A specimen of *Forficula auricularia* taken by Mr. R. A. R. Priske at Deal in September, 1905, having the left cercus normal, while the right was that of var. *forcipata*: W. J. **Lucas.**—Forms of South African Pierine butterflies taken during the dry season of the present year, together with specimens of the same species for comparison taken in the same localities: Dr. F. A. **Dixey.** He said that his exhibit illustrated the fact, now widely recognised, that these forms varied in general correspondence with the meteorological conditions prevailing at the different seasons.—A long series of *Hemerophila abruptaria* bred by the exhibitor illustrating the proportion of light and melanic forms derived from a light male and a light female: E. **Harris.**—A ♂ specimen of *Tortrix pronubana*, Hüb., taken by Mr. Harold Cooper at Eastbourne, either at the end of September or the beginning of October last: S. **Image.** The insect is new to the British list.—*Paper.*—Hymenoptera-Aculeata, collected in Algeria, part iii., Diploptera, by E. Saunders, F.R.S.: Commander J. J. **Walker.**

Linnean Society, November 16.—Mr. C. B. Clarke, F.R.S., vice-president, in the chair.—*Exhibitions.*—Specimens of British water Ranunculi, showing the modifications in the form of the leaves: H. and J. **Groves.** The authors pointed out that the species might be roughly grouped under three headings:—(1) those in which only broadly lobed aërial leaves were produced; (2) those in which submersed multifid leaves with capillary segments were also produced; and (3) those with multifid leaves only.—Photograph showing, of the natural size, the otoliths from thirty-five species of fishes, a collection made by the late Dr. David Robertson: Rev. T. R. R. **Stebbing.**—Leaf and seed of *Macrozamia spiralis* from Queensland, where the plant is stated to cause symptoms of paralysis of the hind-quarters of cattle eating the leaves: E. M. **Holmes.** The chemical nature of the constituents of the plant appears to be unknown.—*Papers.*—Contributions to the embryology of the Amentiferæ, part ii., *Carpinus Betulus*: Dr. Margaret **Benson,** Miss E. **Sanday,** and Miss E. **Berridge.** Material was collected early in July, 1902, and 1904, and more than 600 series of sections were obtained through ovules containing the earlier stages in the development of the embryo-sacs, until the first segmentation of the definitive nucleus had occurred. Former observations (see part i. in *Trans. Linn. Soc.*, ser. ii., bot. iii. (1894), pp. 409–424) were confirmed, and the following new facts obtained. The polar nuclei meet at the neck of the cæcum, descend together, and generally fuse near its base. The pollen-tube enters the sac in their vicinity, and emits one gamete into the cæcum, usually by means of a short spur. The gamete then makes its way to the definitive nucleus. The other gamete is carried up by the tube to the egg, with which it fuses. The egg then becomes clothed with a wall, and segmentation commences.—The membranous labyrinth of five sharks: Prof. C. **Stewart,** F.R.S.

PARIS.

Academy of Sciences, December 4.—M. Troost in the chair.—Contribution to the study of the distribution of the tsetse fly in French West Africa: A. **Laveran.** Since writing the earlier notes on the same subject, the author has accumulated additional material, details of which are now given.—On the deformation of quadrics: C. **Guichard.**—On Bode's law and the inclinations of the planetary equators to the ecliptic: E. **Belot.**—On the intrinsic brightness of the solar corona during the eclipse of August 30, 1905: Charles **Fabry.** The instrument used was a modified Mascart photometer. The intrinsic brightness found was, at a distance of 5′ from the edge of the sun, and in the direction of the equator, about 720 candles per square metre, or about 0·28 the intrinsic brightness of the lunar surface.—The inertia of the electrons: Marcel **Brillouin.**—On certain experiments relating to the ionisation of the atmosphere, executed in Algeria on the occasion of the total eclipse of August 30, 1905: Charles **Nordmann.** A continuous record of the positive ions present in the air was obtained, the instrument destined to measure the amount of negative ions being broken in transit. The curve given by the ionograph showed a marked minimum during the eclipse, thus agreeing with the views of Lenard, Elster and Geitel, who regard the solar radiation as one of the direct or indirect factors in atmospheric ionisation.—On the equilibrium diagram of the iron-carbon alloys: Georges **Charpy.** The influence of the rate of cooling on the composition of the casting has been neglected by the earlier workers on this subject. Details are given of a study of an alloy containing 2·90 per cent. of carbon, for which the Bakhuis-Roozeboom diagram is drawn.—The action of silicon on pure aluminium; its action on impure aluminium; silico-aluminides: Em. **Vigouroux.** Silicon does not form a definite compound with pure aluminium, but in presence of a third metal silicides of aluminium and this metal are formed, well defined crystallised substances, silico-aluminides.—On α-decahydronaphthol and the octahydride of naphthaline: Henri **Leroux.** α-Naphthol, treated with hydrogen by the method of Sabatier and Senderens, gives the decahydride, the details of the preparation and properties of which are given in the present note. Treated with a dehydrating agent it loses a molecule of water and gives an octahydride of naphthalene.—On victorium and the

ultra-violet phosphorescence of gadolinium: G. **Urbain.** The phosphorescence spectrum is given by one element when small quantities of a second element, called the excitor, are present. Either of these, in the pure state, gives no phosphorescent spectrum. These considerations have been applied to the examination of gadolinium, and the author regards the spectrum attributed to a new element, victorium, by Sir W. Crookes as due to a complex containing gadolinium.—On the existence of caoutchouc in a genus of Menispermaceæ: Jacques **Maheu.**—On prulaurasine, a crystallised cyanhydric glucoside extracted from the leaves of the cherry laurel: H. **Hérissey.** The method of obtaining this glucoside in a pure crystallised state from the leaves is given. Its formula appears to be $C_{14}H_{17}NO_6$, and under the action of emulsin it is hydrolysed to hydrocyanic acid, glucose, and benzoic aldehyde. It is an isomer of the amygdonitrile-glucoside of Fischer and the sambunigrin of Bourquelot and Danjou.—On the retrocerebral organ of certain rotifers: P. Marais **de Beauchamp.**—On phototropism of the larvæ of the lobster: G. **Bohn.**—On the geological structure of the eastern Pyrenees: Pierre **Termier.**—On the orientation which an elongated body will take when turning in a current of fluid: E. **Noël.**—On the Devonian fossils of the eastern Ahenet collected by M. Noël Villatte: Émile **Haug.** The collection of fossils made in the course of the Laperrine expedition is sufficient to prove the presence of the three principal subdivisions of the Devonian system, but the stratigraphical relations between the different terms cannot be exactly made out.—The influence of the summer rains on the yield of springs in the plains: M. **Houllier.**—The magnetic effects of lightning on volcanic rocks: Gaetano **Platania** and Giovanni **Platania.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY, at 4.30.—An Investigation into the Structure of the Lumbo-sacral-coccygeal Cord of the Macaque Monkey (*Macacus sinicus*): Miss M. P. Fitzgerald.—On the Distribution of Chlorides in Nerve Cells and Fibres: Prof. A. B. Macallum and Miss M. L. Menten.—The Mammalian Cerebral Cortex, with Special Reference to its Comparative Histology. I. Order Insectivora: Dr. G. A. Watson.—Observations on the Development of Ornithorhynchus: Prof. J. T. Wilson and Dr. J. P. Hill.—Further Work on the Development of the Hepatomonas of Kala-Azar and Cachexial Fever from Leishman-Donovan Bodies: Dr. L. Rogers.—The Action of Anæsthetics on Living Tissues. Part I. The Action on Isolated Nerve: Dr. N. H. Alcock.—Report on the Psychology and Sociology of the Todas and other Indian Tribes: Dr. W. H. R. Rivers.—On the Sexuality and Development of the Ascocarp of *Humaria Granulata*, Quel.: V. H. Blackman and Miss H. C. I. Fraser.—On the Microsporangia of the Pteridospermeæ with Remarks on their Relationship to Existing Groups: R. Kidston, F.R.S.—The Araucarieæ, Recent and Extinct: A. C. Seward, F.R.S., and Miss S. O. Ford.—On the Spectrum of the Spontaneous Luminous Radiation of Radium. Part IV. Extension of the Glow: Sir William Huggins, K.C.B., O.M., F.R.S., and Lady Huggins.

MATHEMATICAL SOCIETY, at 5.30.—On Well-ordered Aggregates: Prof. A. C. Dixon.—Tables of Coefficients for Lagrange's Interpolation Formula: Col. R. L. Hippisley.—On the Representation of certain Asymptotic Series as Convergent Continued Fractions: Prof. L. J. Rogers.—On a New Cubic Connected with the Triangle: H. L. Trachtenberg.—Some Difficulties in the Theory of Transfinite Numbers and Order Types: Hon. B. A. W. Russell.—The Imaginary in Geometry: J. L. S. Hatton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Charing Cross Company's City of London Works: W. H. Patchell.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned Discussion*: The Seventh Report to the Alloys Research Committee: On the Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, and Messrs. R. A. Hadfield and Percy Longmuir.—*Paper*: Behaviour of Materials of Construction under Pure Shear: E. G. Izod.

PHYSICAL SOCIETY (at Royal College of Science, South Kensington), at 7.—Exhibition of Electrical, Optical and other Physical Apparatus.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests of Street Illumination in Westminster: E. E. Mann.

AËRONAUTICAL SOCIETY, at 8.—The Acoustical Experiments carried out in Balloons by the late Rev. J. M. Bacon: Miss Gertrude Bacon.—The Aeromobile: F. Webb.—A New Continuous Impulse Petrol Motor for Dynamic Flying Machines: W. Cochrane.

MONDAY, DECEMBER 18.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Anthropogeographical Investigations in British New Guinea: Dr. C. G. Seligmann and Dr. W. Mersh Strong.

SOCIETY OF ARTS, at 8.—The Measurement of High Frequency Currents and Electric Waves: Prof. J. A. Fleming, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—Canadian Vital Statistics; with Particular Reference to the Province of Ontario: M. D. Grant.

TUESDAY, DECEMBER 19.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Economy in Factories: H. A. Mavor.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Origin of Eolithic Flints by Natural Causes: S. H. Warren.

ROYAL STATISTICAL SOCIETY, at 5.—The Decline of Human Fertility in the United Kingdom and other Countries as shown by Corrected Birth-Rates: Dr. Arthur Newsholme and Dr. T. H. C. Stevenson.—Changes in the Marriage- and Birth Rates in England and Wales during the Past Half-century, with an Inquiry as to their Probable Causes: G. Udny Yule.

WEDNESDAY, DECEMBER 20.

GEOLOGICAL SOCIETY, at 8.—(1) The Clunian Series of the Ludlow District.—Miss G. L. Elles and Miss I. L. Slater; (2) The Carboniferous Rocks of Rush (County Dublin): Dr. C. A. Matley, with an Account of the Faunal Succession and Correlation by Dr. A. Vaughan.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Kite Observations from a Trawler in the North Sea: G. C. Simpson.—Investigation of the Upper Air in the West Indies by Means of Kites: C. J. P. Cave and W. H. Dines, F.R.S.—Temperature Observations during the Partial Solar Eclipse, August 30, 1905: W. H. Dines, F.R.S.—Comparison between Glaisber's Factors and Ferrel's Psychrometric Formula: J. R. Sutton.—A Rapid Method of finding the Elastic Force of Aqueous Vapour, &c., from Dry and Wet Bulb Thermometer Readings: Dr. J. Ball.

SOCIETY OF ARTS, at 8.—The Aërograph Method of Distributing Colour: Charles L. Burdick.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A "Fern" Fructification from the Lower Coal-measures of Shore, Lancashire: D. M. S. Watson.—Exhibition of Balsam mounted Slides by the late Andrew Pritchard.

SOCIOLOGICAL SOCIETY, at 8.—The Russian Revolution and its Consequences: Dr. G. de Wesselitsky.

THURSDAY, DECEMBER 21.

LINNEAN SOCIETY, at 8.—Report on the Vienna Botanical Congress: Dr. A. B. Rendle.—*Cyrtandraceae malayanae novae*: Dr. Franz Kränzlin.—On Characæ from the Cape, collected by Major A. H. Wolley-Dod: H. and J. Groves.—Note on the Distribution of Shortia, Torr and Gray: B. Daydon Jackson.

CHEMICAL SOCIETY, at 8.30.—The Relation of Position Isomerism to Optical Activity. Part V. The Rotation of the Menthyl Esters of the Isomeric Dibromobenzoic Acids: J. B. Cohen and I. H. Zortman.—Azo-derivatives from α-Naphtho-methylcoumarin: J. T. Hewitt and H. V. Mitchell.—The Supposed Identity of Dihydrolaurolene and of Dihydro*iso*laurolene with 1:1-Dimethylhexahydrobenzene: A. W. Crossley and N. Renouf.—The Slow Combustion of Carbon Disulphide: N. Smith.

CONTENTS.

THURSDAY, DECEMBER 21, 1905.

THE JAR AND THE GENIE.

The Theory of Experimental Electricity. By W. C. D. Whetham. Pp. xi+334. (Cambridge: The University Press, 1905.) Price 8*s.* net.

Electric Railways: Theoretically and Practically Treated. By S. W. Ashe and J. D. Keiley. Pp. 285. (New York: D. Van Nostrand Co.; London: Archibald Constable and Co., Ltd., 1905.) Price 10*s.* 6*d.* net.

Modern Electric Practice. Vol. vi. Edited by M. Maclean. Pp. vi+318. (London: The Gresham Publishing Co., 1905.) Price 9*s.* net.

THERE is a tale in the "Arabian Nights" of a fisherman who, after a day's ill luck, cast his net for the fourth and last time with a prayer to Allah that he might have a good haul. He drew to shore a copper jar of curious construction and mysteriously sealed, which on being opened was found to have confined a genie possessed of remarkable powers. As the genie proposed to reward his liberator by taking his life, the fisherman induced him to return into the jar, in which he again confined him. About two centuries ago the body of fishermen who called themselves then natural philosophers drew to shore from the sea of natural phenomena a similarly remarkable jar capable also of confining a very powerful genie. The discovery of the Leyden jar, we are told, "caused the greatest excitement in Europe and America," two continents which three years ago exchanged congratulatory messages across 2000 miles of ocean by means of Leyden-jar sparks. This, the most recent sensational demonstration of the powers of the genie, is by no means the most important; he has truly produced as great a revolution in the doings of mankind as any of his imaginary predecessors.

Ever since the genie has been released the fishermen have been divided into two camps; those who were most interested in studying the jar with the view of discovering the wonderful properties by which it could confine so powerful an agent, and those who have preferred to take such things for granted and have devoted themselves to putting these powers to the service of mankind. As time has advanced the work of each camp has become more and more differentiated, the "theorists" pressing always deeper and deeper into the region of first causes, but ever and again bringing to the surface some fresh discovery on which the "practical men" are quick to seize and which they soon adapt to useful purposes. Thus each continues to supplement the work of the other until it is hard to tell to which is owed the greater debt of gratitude—to those but for whom the powers of the genie would have remained concealed, or to those but for whom they would have remained discovered but unused.

Mr. Whetham's book is an admirable exposition of all that the theorists have discovered so far. "To some extent," he writes in the preface, "even a scientific text-book must be a piece of literature and a work of art." "Experimental Electricity" can certainly claim to be both. The present writer does not profess to be very old, but the development of electrical theory has been so rapid since he first studied its elements that the text-books from which he learnt are more out of date than is Euclid as a text-book of modern geometry. An elementary text-book should give a comprehensive survey of the whole of its subject in such a way as to stimulate the curiosity and imagination of the student and this the book before us does. It is written in a clear and simple style, and the mathematics necessary are such as any student beginning his university career should have at hand. A very prominent and valuable feature of the book is the frequent reference to and quotation from the works of the founders of modern electrical theory, notably Faraday and Maxwell. The story which it tells of the development of this theory from the first suggestions of Faraday to the most recent conceptions of J. J. Thomson, Larmor, and others is one of extraordinary fascination and interest, and we cannot conceive any earnest student laying down the book without a desire to help to the best of his ability in solving the riddle with which it closes.

Books such as Mr. Whetham's should be read not only by the student who wishes to enrol himself in the scientific camp, but also by those who intend to become engineers. The engineer can never be the worse for a sound knowledge of what the men of science are doing. Incidentally he may be prevented from making some of the mistakes which Messrs. Ashe and Keiley make in the first chapter of their otherwise excellent book on electric railways. For example, these writers in the course of a few lines speak of the watt, first as power, then as work, and finally as energy. But after a few pages of this "miscallin' technicalities" they proceed to the more serious business of their book, and here there is little to which objection can be raised. The book is a good example of some of the feats that the genie has accomplished. It is a good example, too, of the extreme specialisation so characteristic now of all branches of electrical engineering. The title is somewhat broad, as the subject-matter is practically confined to rolling stock and rolling-stock equipment. The illustrations are plentiful and very clear.

If those who would learn what the jar is made of should study Mr. Whetham's book, those who would know in a general way the genie's powers should read "Modern Electric Practice," of which the present volume is the sixth and last. We have already reviewed the previous volumes and have pointed out what we consider to be somewhat serious defects in the plan and general arrangement of the work. Still, as a general summary of all the modern applications of electricity these volumes are not to be despised, especially when their very numerous illustrations are remembered. We would like to suggest that in future editions these are published without the text. The present volume contains very good articles on telegraphy and telephony; the article on electromedical appliances is disappointing in the extreme. There is in addition a good index to the whole six volumes.

The three books the titles of which head this review are typical of the three classes of men who have made the electrical industry. Mr. Whetham's of the seekers after truth who are always asking for more light and have discovered all the fundamental principles on which the industry is based, Messrs. Ashe and Keiley's of the pioneers who have developed the practical possibilities of these principles, and "Modern Electric Practice" of the great majority who are content to follow where others lead but whose united efforts have placed at the disposal of all mankind the forces latent in the philosopher's jar. MAURICE SOLOMON.

HYGIENE AT SCHOOL.

Text-book of Hygiene based on Physiology for the use of School Teachers. By A. Watt Smyth. Pp. xvi+256. (London: Simpkin, Marshall and Co., Ltd.) Price 6*s*.

MRS. WATT SMYTH rightly says in her preface that

"Physiology is the science of the action of the body in health, hygiene the practical application of this science; it is obviously impossible to understand the laws of hygiene without a knowledge of the fundamental principles of physiology."

She has set herself the task of providing a text-book of hygiene founded upon physiology, for the use of teachers, in order that they may comprehend the hygienic needs of the pupils committed to their charge. Hitherto the books written with this object (and there are several) have either been good as text-books of elementary physiology and bad as text-books of elementary hygiene, or *vice versâ*; and Mrs. Watt Smyth is to be congratulated upon having brought these two subjects, which are so intimately associated with each other, into a fairly satisfactory relationship, and upon having dealt with each in a very commendable manner. It must be said, however, that the physiological matter of the book is the better, and that in many instances the hygienic matter could have been presented in greater fulness of detail with advantage. The space given to physiology far exceeds that devoted to hygiene, and while the demands of the former subject upon space are necessarily somewhat greater, there can be no two opinions that the physiology in many respects is too elaborate for the purpose to which this book is dedicated. Some non-essential matter is included; for instance, a description is given of the ethmoid bone, the number of bones it articulates with, and the time when ossification is complete; the number of separate centres of ossification is also given of other cranial bones; the minute structure of the salivary glands is entered into with unnecessary fulness, for the teacher is informed that

"the secreting cells of the salivary glands are of two main types, according as the secretion of the gland is mainly serous or albuminous (Parotid), mainly mucous (sub-lingual) or both (sub-maxillary). In a gland that has not been recently secreting, the mucous secreting cells, which are round or oval, are distended with a clear substance, mucigen, from which mucus is formed when the gland becomes active. The cells of the glands which yield an albuminous secretion are cubical and almost fill up the acini. Their protoplasm is full of dark granules before secretion occurs; when it begins, the granules diminish in number and finally almost completely disappear."

These instances are referred to as illustrations of a certain lack of appreciation, which is evident here and there, of what is essential and what is not; for it is impossible to see what practical application can be claimed of the knowledge of the above facts. The illustrations and diagrams, moreover, are anatomical and histological. There is no single illustration of any form of sanitary apparatus or appliance, and these matters are referred to in the text often in such a cursory manner that the reader would find it impossible to form a satisfactory conception of their true nature.

Mrs. Watt Smyth deals with each subject on an excellent plan. First she gives a brief account of the physiology of the subject discussed (with special reference to any notable feature of these physiological processes in childhood), and then she proceeds to deal with the hygienic principles and practices which rest upon these foundations. Her scheme is well illustrated in the chapter on respiration and air; the nose, larynx, trachea, and lungs are first described, then the mechanism of respiration is explained, next the constitution of the air prior and subsequent to respiration is set out, and then there follows the consideration of the problems of ventilation and heating, and the evil consequences which result when these provisions are insufficient or faulty.

The other chapters of the book fairly cover the necessary ground, and the chapters upon the special senses and the muscular system (the latter including a syllabus of physical exercises based on the Swedish system) are very complete.

In conclusion, reference should be made to the great care which has been exercised in the preparation of this work. The facts set out are entirely accurate and the opinions expressed are sound, without exception. The author acknowledges her indebtedness for information and counsel from such authorities as Dr. Dawson Williams, Dr. James Kerr, and Miss Turner.

REGENERATION IN ROOTS.

Studien über die Regeneration. By Prof. B. Němec. Pp. 387; with 180 figures in the text. (Berlin: Gebr. Borntraeger, 1905.) Price 9.50 marks.

IN this somewhat bulky volume the author describes and discusses at some length the result of his numerous experiments on the regenerative processes that occur in wounded roots.

It is well known that if the tip be removed from a growing root a new apex is commonly differentiated, growth in length commencing once more when the new tip has become completely formed. The objects of Dr. Němec's investigation have been to endeavour to throw some light on the nature of the process of regeneration itself, the causes that initiate and determine its occurrence, and the meaning of the physiological events that are associated with it. The

methods adopted were extremely simple. The tips of growing roots, chiefly of seedlings, were injured in various ways by making incisions into the region about the apex, and the reactions that ensued were carefully followed and compared.

It was found, in confirmation and extension of the less complete observations of Prantl and of Simon, that the roots of ferns never truly regenerate themselves as do those of flowering plants. Possibly the difference is to be attributed to the more definite concentration of formative protoplasm in the apical cell of the former, as contrasted with its greater extension as layers in the roots of the latter. At any rate, no regeneration occurs in the roots of ferns, although some attempts at healing the actual wound may be made.

The case is different with the roots of phanerogams, although in them also the conditions of regeneration are more limited than might have been anticipated. In the first place, no union of the halves of longitudinally cut roots took place; the damaged apex was either replaced by a new one on either side of the slit or else the regeneration was confined to one half.

An annular incision made just behind the tip of the root into the cortex and extending as the endodermis fails to give the stimulus requisite to produce a fresh apex. Healing of the wound is more or less in evidence, but the original apex continues to function, and to supply cells for the further growth and elongation of the root. But if the knife has passed through the next layer, the pericycle, regenerative phenomena at once set in. A new apex, with all the complicated layers, is formed just behind (*i.e.* proximally to) the wound, and it is especially interesting to discover that the statolith starch now disappears from the original tip, to be transferred to, or at any rate to reappear in, the new one.

Lateral incisions are ineffective to bring about the differentiation of a new apex unless the slit has severed at least half the circumference of the pericycle. If this be done regeneration takes place, with the concomitant appearance of statolith starch in the new organ. All the experiments made on the roots go to emphasise the great importance of the pericycle in connection with regenerative processes, although it is not from this layer itself that the new tip is differentiated, but from the indifferent plerome cells within it. The damage done to the pericycle appears to act as an interruption of the coordinative relations between the various parts of the embryonic region as a whole. When this coordination is thus interrupted the capacity of giving rise to entire organs that is resident in the embryonic protoplasm asserts itself, and the new formation thus appears. We know as a matter of fact that the pericycle retains the embryonic condition until relatively late, since from it arise the normally produced lateral roots. Of course, the processes underlying the regenerative processes are by no means cleared up by the experiments indicated above, but at any rate certain definite facts have been ascertained, and further lines of profitable investigation readily suggest themselves.

Comparatively few anomalous cellular effects were observed. In the exceptional case of one fern root, however, the nuclei of the healing (not regenerative) cells exhibited irregularities both in their modes of division and in the number of their chromosomes which were commonly excessive. Multinucleate cells were also observed in the plerome of a wounded root of Ricinus, but they apparently took no part in the actual regenerative processes.

The book as a whole forms an important contribution to the literature of regeneration, its chief merit perhaps lying in the numerous problems it suggests for future investigation. It contains a bibliography that should be useful, but it would have been materially improved by the addition of a good index.

OUR BOOK SHELF.

Heredity. By C. W. Saleeby, M.D. Pp. 118. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s.* net.

The appearance of a little shilling book on heredity is almost startling, when we consider the difficulty of the subject and the relative youth of its exact study. That a book like this should be possible indicates that considerable progress has been made in recent years. Was it not Leibnitz who said, "The more a science advances, the more it becomes concentrated in little books"? But it indicates also a noteworthy skill on the author's part. Without attempting to slur over difficult themes, *e.g.* Mendelism, as if they were easy, he has given us a clear and interesting exposition, which will be widely appreciated. It is a wonderful *multum in parvo*, dealing lucidly, for instance, with the contrast between hereditary resemblance and variation, between the germ-plasm and the body, between germinal variations and somatic modifications, between inherited nature and the results of nurture, between inborn and congenital characters, and so on. Even to have made these distinctions clear, so that they may be understanded of the people, is an achievement. As was natural in a book of this kind, the author takes up an eclectic position, and quotes freely from various writers—from one about ten times. He is inclined to allow that there is a limited transmission of "acquirements" or modifications, but the only instance we have found is an inept one—that bacteria may transmit an exaltation of their virulence. He agrees with Dr. Archdall Reid on many points, *e.g.* that amphimixis never produces more than regressive variations, but does not think that this author satisfactorily accounts for the origin of spontaneous variations. He has the same complaint to make of Weismann, but in regard to a view which that progressive biologist no longer holds, as, indeed, the author seems to know (p. 54). We may also note that even in "The Germ-Plasm" Weismann did not teach that "parthenogenetic species cannot vary"; in fact, he made experiments showing reversion in parthenogenetic generations of Cypris. There is a useful chapter on "physical degeneration," but we do not understand the author when he says that those who believe in progressive degeneration "have it incumbent upon them to demonstrate either the falsity or the suspension of the law of natural selection." Surely the many "degenerate" animals that we know have not become what they are without the help of selection. Another point that we do not understand is how the fact that "one-half of the nuclear chromatin of each gamete is thrown aside prior to the fusion of the two nuclei," "obviously

corresponds exactly with Galton's assertion that the two parents between them contribute one-half of the total heritage of the offspring." There is surely a screw loose here. Dr. Saleeby's vivacious style will fascinate some readers and help them over difficult themes, but we wish that he had been sometimes less conversational, as when he speaks of the Bathmic theory of organic evolution as "an amusing piece of nonsense." J. A. T.

The Practical Photographer. Library Series. Nos. 24, 25, and 26. 24 and 25, Pictorial Printing, parts i. and ii. Pp. xx+64 and xx+64. 26, Artificial Light and Night Photography. Pp. xx+64. Edited by Rev. F. C. Lambert. (London: Hodder and Stoughton, 1905.) Price 1s. net.

WE have before us three more additions to this very practical and useful series of photographic handbooks, with which most of our photographic readers are now well acquainted. The first two are devoted to pictorial printing, in which are brought together many methods by which the negatives may be altered, the print controlled during printing, or generally or locally modified according to desire.

For the most part No. 24 treats chiefly of the employment of one negative only, while No. 25 is devoted chiefly to combination printing and enlarging, cloud negatives, and cloud printing. Both numbers are preceded by interesting and well illustrated *résumés* of the pictorial work of Bessie Stanford and Percy Lewis, which to the beginner should serve as admirable types of high order work.

The third number belongs to quite another branch of photography, namely, that in which the incident light on the object is for the most part artificial, such as flashlight, candle light, gas light, acetylene, &c. Here we have a collection of notes by numerous workers, all of whom have secured some interesting pictures by one or other of these methods. As before, the reader is not left to gather his ideas from the text alone, but is introduced to some interesting pictures with notes describing under what conditions they were taken. This number also contains an account by the editor of the pictorial work of J. C. Warburg, with a reproduction of many of his most typical photographs.

These three numbers thus form a welcome addition to those previously published, and will certainly be appreciated by those workers to whom they specially appeal.

Introduction to the Study of Organic Chemistry. By John Wade, D.Sc. (Lond.). New and enlarged edition. Pp. xx+646. (London: Swan Sonnenschein and Co., Ltd., 1905.) Price 8s. 6d. net.

THE fact that the present volume has reached its second edition points to the public appreciation of Dr. Wade's book. This is not surprising.

The arrangement of the subjects bears evidence of the author's thought, and the immense number of facts compiled speaks eloquently of his industry.

There are several novel features to which the author directs attention in the preface, and which possess certain merits. There is no doubt that charts or surveys, which serve to show, in a condensed form, the relation of a variety of compounds, are an aid to the memory, and the author has introduced them freely.

The principle of making a thorough study of a single common substance like ethyl alcohol and then dealing with its more important derivatives before thrusting the student into the tangle of homologous series has very much to recommend it.

Perhaps the title of the book is a little misleading. One would be inclined to suppose that a student who was familiar with these 624 pages of closely printed matter might be regarded as a well informed organic chemist; but he has only an introductory knowledge. We must express our respect for those who have passed beyond this "introduction," whilst others who may be examined in the information required by Dr. Wade's introductory standard demand our sympathy. The illustrations exhibit rather too plainly the defects of photography applied to glass apparatus, though they possess a realistic character which may appeal to the student. We are glad to notice the author's respect for the traditional spelling of the word *radical.* J. B. C.

The Romance of Insect Life. Interesting Descriptions of the Strange and Curious in the Insect World. By Edmund Selous. With twenty-one illustrations by Lancelot Speed and Carton Moore Park. Pp. 352. (London: Seeley and Co., Ltd., 1906.)

THE letterpress consists of a series of extracts, derived from a variety of sources, relating to ants, termites, locusts, butterflies, water-insects, fireflies, scorpions, &c., connected together by general observations on all kinds of subjects. Occasionally the compiler's remarks on the senses of insects or on mimicry are worthy of notice, but they are frequently in bad taste and often inaccurate, which is not surprising, as we are constantly told that he is only quoting his data second-hand, and has not seen the original records.

This is a pretty book, but otherwise we regret that we have little to say in its praise. The author suggests that the genus of grasshoppers called "Scudderia" were so named because they "scud," though Scudder's name is actually referred to on the opposite page. As an illustration of style and inaccuracy we may quote the following:—"From 1778 to 1780 a dreadful curse of locusts, alluded to by Southey in his 'Curse of Kehama,'—or perhaps forming the subject of that poem—I really don't know—fell upon the Empire of Morocco." There are *two lines* relating to locusts in the "Kehama," and it is "Thalaba" in which they are noticed at greater length.

There are really only sixteen page illustrations, some of them being double—*i.e.* divided in the middle, and thus making up the twenty-one of the title-page.

Most of our scientific men must be very far behind other people, for Mr. Selous tells us, "Everybody knows nowadays how all the different species of animals and plants, living and extinct, have come into existence," &c., &c.

Errors in Latin names abound, the worst being Orthoptera for Ornithoptera wherever it occurs. It is a pity that a book intended to popularise natural history should not have been more carefully written and edited. It almost looks as if the compiler thought anything would be good enough for his prospective readers.

The Art and Practice of Laundry Work for Students and Teachers. By Margaret Cuthbert Rankin. Pp. 191. (London: Blackie and Son, Ltd., 1905.) Price 2s. 6d.

THERE is little that is scientific in this book; it gives the impression, indeed, that even the teachers of laundry work are guided by empirical rules. It should be possible to inculcate the broad scientific principles upon which the art and practice are based while teaching girls how to do their laundry-work successfully. The washing of clothes, and the other processes through which they pass in the laundry, would then not be matters of rule of thumb, but intelligent applications of scientific principles to particular purposes.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radio-activity of Ordinary Matter in connection with the Earth's Internal Heat.

MR. CAMPBELL's letter in your last issue (p. 152) reminds me of a point to which I have intended for some time to direct attention. Prof. Rutherford ("Radio-activity," second edition, p. 494) has calculated that the radio-activity required to compensate for the earth's internal heat is much exceeded by the (apparent) activity of ordinary materials, as determined by me (*Phil. Mag.*, June, 1903).

Thus the smallest activity I observed was about 10^{-4} times that of uranium nitrate, or 7×10^{-11} times that of radium: whereas the amount of activity, per unit mass of the earth, required to compensate for the loss of internal heat is only $4{\cdot}6\times10^{-14}$, or less than one-thousandth part of the activity computed to be actually there.

We cannot well assume a much smaller apparent radio-activity for the unknown material of the earth's interior, for all materials hitherto examined have given effects of the same order of magnitude, the radio-active elements, of course, excepted.

The simplest way out of the difficulty is to suppose that the apparent radio-activity of ordinary materials is not a volume effect of the same nature as that of radium, but that it is merely a superficial effect of quite a different kind, and only occurring at an exposed surface. It is difficult to understand why Prof. Rutherford did not draw some such conclusion. I do not know if he doubted the correctness of my results. It is easy, however, to confirm them from other sources. Thus C. T. R. Wilson (*Proc. Roy. Soc.*, vol. lxviii. p. 158) found the current through the air in a vessel of 163 c.c. capacity equal to $2{\cdot}0\times10^{-6}$ electrostatic units per second; this is equivalent to 7×10^{-17} electromagnetic units. Madame Curie ("Thesis," p. 14) found the current through a flat vessel of about the same size, the bottom being covered with uranium nitrate, equal to 7×10^{-13} (electromagnetic). If this vessel had been wholly lined with uranium, the current would have been more than doubled, say 2×10^{-12}. Thus the ratio of activities may be put at 3×10^{4}, as against 10^{4} in my own experiments. Considering the various activity of ordinary materials, and the rough nature of the comparison in both cases, this measure of agreement is fully confirmatory.

As the question of the earth's internal heat has been raised above, I may mention that I am engaged on an extensive investigation of the amount of radium contained in various rocks. The majority of those rocks which I have as yet tried (chiefly sedimentary) contain a good deal more radium than the percentage which would keep up the heat supply. Much more, however, must be done before any confident statement can be made as to the average amount of radium in the earth's crust.

Experiments are also in progress with native iron, both terrestrial and meteoric, with the idea that this may be representative of the composition of the earth's interior.

Sunnyside, Cambridge. R. J. STRUTT.

Magnetic Storms and Aurora.

IN his letter in your issue of December 14 (p. 152) Mr. F. C. Dennett assigns a positiveness and a generality that were not intended to the statement in my previous letter that on November 12 "no special auroral display seems to have been noted in this country." In years of sun-spot maximum, in the belt of greatest auroral frequency, nights wholly free from aurora are probably the exception. In the Shetlands, or even in the north of Ireland, aurora is a much more common phenomenon than in the south of England.

On November 15 I learn from several sources that the aurora was particularly brilliant, and the apparent movements especially lively during the time 8.53 to 9.25 p.m., when the large declination movement occurred. Various Arctic explorers have stated that it is only when the aurora displays this variable character that there is any clear connection between it and magnetic disturbances in those regions where both phenomena have their maxima. The aurora on November 12 is said by the Lisburn observer to have been of "the usual type" exhibiting "a steady glow." It would be interesting to know whether this aurora was observed at Lisburn or elsewhere *during the time of the large declination movement* (6.30 to 7.10 p.m. G.M.T.), and, if so, whether it then showed none of the brilliant and variable phenomena seen during the time of the large declination movement three days later.

For aurora to be observed on thirteen days in less than three weeks must, I think, be rather an unusual event for any place in England or Ireland; the Lisburn observer must keep a sharp look-out. CHARLES CHREE.

December 16.

The Total Solar Eclipse of August 30.

IN visiting Spain at the end of August of this year I was actuated by the desire once again, after an interval of twenty-three years, to witness the marvellous and unique phenomenon of a total solar eclipse. It is a sight which cannot be imagined—it must be seen. Happening at a time of maximum sun-spot frequency, it was reasonable to expect a considerable display of protuberances, and I wished to form my own idea of their size by checking their persistence or non-persistence through the phase of mid-totality on a day which otherwise may be taken to have been chosen at random. For this purpose a station on, or very close to, the line of central eclipse was essential. Torreblanca was chosen because it was the station of the Barcelona and Valencia railway which was nearest to the line of central eclipse, lying, in fact, about a mile to the south-west of it.

I observed the eclipse from the railway station, the position of which is lat. 40° 12′ N. and long. 0° 12′ E. (Greenwich). The railway and official time in Spain is that of Greenwich. By the clock at the railway station, mid-totality occurred between 1h. 18m. and 1h. 19m. p.m. Before the beginning of the eclipse I entered in my note-book half the expected duration of totality, 1m. 50s.; when I had observed the second contact, I wrote the time underneath, and, by addition, ascertained the time of mid-totality by my watch. The display of protuberances which appeared just before the moment of second contact, and on the part of the sun's limb which was about to be eclipsed, was, according to all witnesses, exceptionally brilliant. When the time of mid-totality came round I looked for these protuberances. They were absent. Not a trace of them or of any others was visible to the naked eye, and I searched the whole edge of the moon's disc with the greatest attention. Their absence was confirmed by Stephan (*Comptes rendus*, October 9), observing with the best instrumental aid at Guelma.

The sun's true altitude at Torreblanca on August 30, at 1h. 18·5m., may be taken as 54°·5. For this altitude the augmentation of the moon's semi-diameter is 14″·3. Adding this to the geocentric semi-diameter, 16′ 21″·4, as taken from the Nautical Almanac, 16′ 35″·7 is obtained for the apparent semi-diameter of the moon as seen from Torreblanca at mid-totality. Deducting from this the semi-diameter of the sun, namely 15′ 50″·7, we obtain 45″ as a sufficient approximation to the width of the annular band by which the disc of the moon overlapped that of the sun. Therefore, to an observer stationed on the central line in this neighbourhood, no protuberance could be visible at mid-totality which had a height less than 45″, and, neglecting the small displacement of Torreblanca from the central line, the protuberances of second contact, magnificent though they were, could not have exceeded this height.

Eight seconds before second contact I detected the streamers of the outer corona on the western limb of the moon. At this moment there was no trace of the inner corona, which presents to the spectator during the whole of totality the appearance of a bright, luminous ring surrounding the moon.

If we assume that the argument from parallax is applicable to the inner corona, as it is to the protuberances, we have to conclude that, eight seconds before second contact, the light-giving portion of it did not extend further than

between 93″ and 94″ from the western limb of the sun. To an observer on the central line, at mid-totality, it is eclipsed to a distance of 45″ from the sun's limb, and this would leave only between 48″ and 49″ as the width of the outer portion, which furnished the unexpected amount of light which persisted through totality. It is clear that if the inner portion, having a width of 45″, had been uncovered, the daylight during totality would have been still more remarkable.

In this respect there was a great contrast between the eclipse of this year and that of May 17, 1882, which I witnessed at Sohag, on the Nile, where a large camp of astronomers of many nations was established. In it, one of the most striking features was the rapid darkening during the last moments before second contact. I have always compared it to what is witnessed when a lecture-room is darkened during the day by quickly closing the shutters of the windows in succession. In 1882 the darkening took place rapidly and completely; and immediately quite a number of stars came out, besides the great comet which revealed itself, all unsuspected, close to the sun's limb, and formed the feature of that eclipse which was most noticed and is best remembered by the spectators. In 1905 the darkening effect was much less striking; but the illustration of the lecture-room holds if we imagine that the shutter of the last window is out of order, and has to remain open during the demonstration.

The contrast between the two eclipses is accentuated when we remember that the apparent semi-diameter of the moon, as seen from Torreblanca, was 45″ greater than that of the sun, while on the Nile this excess was only 15″·4. Therefore a width of 45″ of the brightest part of the corona was eclipsed in 1905, as against only 15″·4 in 1882. If, therefore, the uneclipsed coronas had possessed equal efficiency as furnishers of daylight, the darkness during totality ought to have been much greater in 1905 than it was in 1882; but the opposite was the case. Therefore, whatever may be the process by which the inner corona or luminous ring is produced, it was much more active on August 30, 1905, than it was on May 17, 1882.

December 9. J. Y. BUCHANAN.

The Engineer's Unit of Force.

IN his letter of November 16, your reviewer refers to the "apparent inability of academic writers to understand the engineer's position in this matter." May I, as an "academic writer," state that I have no difficulty whatever in understanding the engineer's position in regard to the gravitational unit of *force*. It is his treatment of *mass* that I do not understand. I am not quite sure whether it is worth while trying to understand it, as it always seems, somehow or other, not to be altogether satisfactory, and I have great doubts at present as to whether it is necessary.

I have always supposed that the great advantage of a gravitation unit of force was that it enables problems in motion under force to be treated *without* introducing the notion of *mass* at all, by means of the relation

$$\frac{\text{force on body}}{\text{weight of body}} = \frac{\text{acceleration produced by force}}{\text{acceleration of gravity}}.$$

Moreover, when we come to deal with mass, if we take a pound as the unit of mass and a pound weight as the unit of force, the numerical measures of the mass and weight of any body will be identical. This is surely simple, intelligible, and convenient.

But instead of this I find that engineers put $W/g=M$ and call M the mass of the body, and that they have adopted a unit of mass, called a slugg, based on this relation, which to my "academic mind" appears both meaningless and useless. If "people do not, and never will, think in poundals," still less will they think in sluggs, and a terminology involving this unit can scarcely be described as "not divorced from common thought and speech." I cannot think any reasonable engineer would expect to see tea and sugar sold by the slugg, and one thing I do not understand is whether, if this custom *were* adopted, I should get the same quantity of tea or sugar at London as at Johannesburg, or whether the grocer would be expected to make allowance for the variations in g.

If, on the other hand, the grocer retained the time-honoured custom of weighing out the sugar by the pound, it would appear that the engineer's estimate of the mass of the sugar depended, not only on the sugar itself, but also on his choice of units of length and time. In these circumstances it seems reasonable to ask whether the engineer still accepts or discards the conventional, but somewhat meaningless, definition of our text-books, "Quantity of matter is called mass."

Is not the writing of W/g equal to M a mere attempt to copy blindly the academic method of treatment, and to adapt it to a system of units to which it is ill-suited? Writing on a similar issue elsewhere, I pointed out on one occasion that I prefer to solve the problem of the three cats killing three mice by some method equivalent to the "rule of three," and not to adopt an artificial unit of cats in order to write the equation mice = cats × minutes.

G. H. BRYAN.

IT will be seen that Prof. Bryan, instead of defining force as the rate of change of momentum, or using the corresponding dynamical equation $F=Ma$, works problems in motion by means of a proportion, his equation being equivalent to $F=W/g\,a$; he thus avoids both the poundal and the slugg. This differs from the two absolute systems previously discussed in that W/g is not here a measure of mass, on account of the variable nature of the gravitational unit of force, as his weight and mass are numerically the same, while g varies with locality. A concrete example well illustrates this system. Suppose a body weighing 32·182 pounds at London to leave the earth under the action of an upward resultant force of one pound, and to travel through space with an acceleration of one foot per second per second. The value of g would continually decrease, but the weight (*i.e.* the gravitational force between the earth and the body) would in this system always be called 32·182 pounds, so that at the instant when g was reduced, say, 50 per cent., the acceleration force, though unchanged in amount, would be called two pounds, in order that Prof. Bryan's proportion should still be true. In fact, the pound force at this juncture would have only half its original absolute value, and would go on diminishing indefinitely; and this system is described as "simple, intelligible, and convenient." The beginner, introduced to dynamics in this fashion, as simply rule of three, with the conception of inertia designedly veiled, endeavouring to think in a variable unit, and with only one name for both force and mass, cannot be considered to have made a very auspicious start, and he may well be forgiven if he is never able to free himself from the tangle. The gravitational system, at any rate, must be ruled out of court.

In the everyday work of the engineer, mere inertia has seldom to be spoken or thought about, and I must still maintain that the engineer's system, with its new inertia unit, is "not divorced from common thought and speech." As a matter of fact, it is much easier to think of inertia in a distinct unit like the slugg than one the name for which is also used for force.

Prof. Bryan is evidently sincere when he says that he does not understand the engineer's treatment of mass. The operation of weighing is not a dynamical one. Inertia does not enter into the matter at all. It is a statical problem in the equilibrium of forces. If the inertia unit were here dragged in as suggested, Prof. Bryan fails to see that the specification in sluggs would be at least as definite as a specification in pounds; and it might be even more definite, for if the grocer in Johannesburg had studied dynamics in the variable gravitational unit, the weigher of the sugar might plausibly argue that, as "the numerical measures of mass and weight," in pounds, are "identical," he was quite justified in using an imported spring balance.

The present confusion is no doubt partly due to the substitution of the word mass for the good old word inertia. If mass means quantity of matter as determined by weighing, then inertia is probably, but not necessarily, proportional to mass. Readers who are interested in the subject may be referred to a correspondence which took place in NATURE about nine years ago (vol. lv.), and especially to letters by Prof. (now Sir) Oliver J. Lodge, Prof. John Perry, and Prof. G. F. Fitzgerald.

THE REVIEWER.

"Mathematics" applied to Chemistry.

IN his notice of my book "Researches on the Affinities of the Elements" in NATURE, November 16, the reviewer impugns the legality of applying mathematical formulæ to my surfaces. I trust I may be allowed to answer briefly my critic's objections. His difficulty as to the non-continuous nature is imaginary, and arises from a mistaking of the object to be achieved—which is simply to obtain either a surface or a mathematical expression from which *can* be deduced the affinities any one element exhibits for any other. This can be done from the formulæ, and they do, therefore, characterise the chemical properties of an element which depend upon these affinities. Although there exist an infinite number of points on the surface which are occupied by no element, yet there exist only a *finite* number of points the x and y coordinates of which are *whole* numbers, and to *every* integer value given to x and y in my formulæ there corresponds a definite element; so that, so long as we keep within the domain of integer numbers (as we are forced to do by the nature of the construction) continuity is attained.

The complexity of the formulæ is more apparent than real, because the only values which x and y can have are integer numbers, and the constant and many terms disappear in practice. GEOFFREY MARTIN.

Kiel, December 6.

IT is true that the plan proposed by Mr. Martin is occasionally used on the convention that only the values of the equations to the curve which occur at the integer points are to be used; but the reviewer still maintains that the principle is a false one. A curve is intended to exhibit *continuous* change, according to some law, and he is unaware that any result of value has ever been obtained by the use of the plan, except, perhaps, that of appealing to the visual sense. THE REVIEWER.

Heat a Mode of Motion in the Seventeenth Century.

THE following statement occurs in the "Medulla Medicinæ," by J. A. Van der Linden, Med. Prof., Franekeræ, 1642, p. 182:—

"Calor est minutissimarum materiæ partium motus in se reverberatus."

Van der Linden was a famous teacher, but the theory may not have originated with him. Are there other co-temporary anticipations of "Heat a mode of motion"?

W. R. GOWERS.

THE PULSE OF THE ATMOSPHERIC CIRCULATION.

SOME fifteen years ago an American eclipse expedition which included Prof. Cleveland Abbe visited St. Helena, and, on leaving represented to the Governor, Mr. R. L. Antrobus, now of the Colonial Office, the importance of establishing a meteorological observatory there. The representation was sent to the Colonial Office, and, the colonial finances being then in a depressed condition, the Colonial Office applied to the Meteorological Council for assistance.

It is needless to spend many words over the meteorological importance of such an enterprise. St. Helena emerges from the sea in the heart of the trade wind of the southern Atlantic. In no part of the globe, perhaps, is the trade wind current so persistent. The trade winds have long been recognised as primary factors of the atmospheric circulation. Speculation on their origin, which still forms the staple of the physical geography of the schools, carries us back to the writings of Halley and Hadley. The south-easterly current over St. Helena is the flow along the main artery of the never-failing atmospheric circulation, and at St. Helena if anywhere we may put our finger on the pulse of that endless and complex process of transformation of solar energy of which the weather of our islands and elsewhere is an expression.

The council, itself not wealthy, had a Robinson anemograph, then lately returned from duty in Heligoland. This was lent to the colony, and with it was found a small annual sum by way of payment for its curator, Mr. Hands, of St. Matthew's Vicarage, who undertook as well the duties of observer for a normal station of the second order, with instruments furnished by the council.

The anemometer continued its run with some unavoidable interruptions, and the observations were taken until the middle of 1904. There are besides observations of rainfall at other stations in the island.

By 1904 that part of the spiral of the direction pencil which had to record south-easterly winds became so worn by constant use that a hollow was formed there and the record had become an unsatisfactory one. With the assistance of the engineer officers stationed at St. Helena the matter was inquired into, and, as a result, the instrument was ordered home for repairs. At the same time an attempt was made in the observatory branch of the Meteorological Office to put together the results of the long run and to collate them with the other observations. I will not anticipate the publication of the results which, I hope, will follow in due course, but to one interesting side of them, too speculative for an official report and too suggestive to be altogether ignored, I would like to direct attention, because it shows a possibility (perhaps more) that with more searching we may find a working connection between the pulsations of the trade wind in the southern hemisphere and the general type of weather in so distant a part of the globe as our own islands.

While the trade winds may be regarded as the most obvious representative of the dynamical effect of solar energy, rainfall must be allowed to be also very closely connected with the process of distribution of that energy. The convection of heat by evaporation from warm water surfaces and condensation in cooler regions represents a process tending towards equalisation of thermal distribution on a gigantic scale. The main directions of transference are from south to north on the one hand, and generally eastward from sea to land on the other. The white snow coverings of the polar regions and the persistent rivers of great continents are permanent records of nature's endeavour to distribute more nearly equally over the globe the supply of solar heat. From a general point of view rainfall or snowfall in the temperate and arctic zones may be regarded as an index, perhaps a spasmodic one, of the general circulation from the tropical regions towards the poles, and to that extent as the counterpart or correlative of the kinetic energy of the trade winds which represent the flow towards the equatorial region. The transformation of energy in rainfall is on a vastly greater scale than that displayed by the trade winds. Supposing that the trade wind at St. Helena is a mile high, the energy represented by the year's flow in a slice of the current a mile in width would be about equal to that represented by a year's rainfall on a single square mile in the neighbourhood of London. Of these two indices of the general process of distribution of solar energy, the one is the steadiest, the other the most fluctuating of all meteorological phenomena, and any indication of an underlying relation between them, which is, in a way, a necessity of the general process of circulation, would be of great meteorological interest and might be of immense economic importance.

So far as I have carried it, the study is perhaps

merely tantalising, but I should like to present the case as it occurred. When the figures for the average wind velocity were being put together, I inquired about the variation from year to year. The monthly values had not been combined, and a glance showed the last year (1903) to be one of exceptionally high velocity. For the complete year, since calculated, it is twenty-one miles per hour; the average for the twelve years is eighteen miles per hour. I noted 1903 as the year of heavy rainfall in this country, and asked about 1893, the year of drought, especially in the spring months. I found the wind velocities at St. Helena were for the first half

Jan.	Feb.	Mar.	Ap.	May	June	
16	14	—	15	14	—	in 1893,

as against

Jan.	Feb.	Mar.	Ap.	May	June	
21	20	16	20	16	19	in 1903.

The first two are the lowest velocities of those months on record; the others are low, but not the lowest. The blanks mean that the instrument was not working properly. This suggested some sort of connection, a stronger trade wind being associated with a heavier rainfall in this country. I obtained the monthly values and plotted the several years' variation. There was unmistakable evidence of a large seasonal variation with a maximum in September and a minimum in May. I plotted the average seasonal variation of the St. Helena wind for the twelve years, and against it the seasonal rainfall in the south of England for thirty-five years, which I happened to have at hand. The curves are reproduced in the figure (Fig. 1). The similarity is surprising. Of course, the seasonal rainfall is not the same in all localities, even in the British Isles. Somewhat similar curves are, however, to be found for Stykkisholm, in Iceland, and for Hakodate, in Japan, so that the case was not quite an isolated one. I was, therefore, not without hope that the evidence for organic connection would develop with further investigation. When plotting the curves of wind velocity for individual years, I noted that 1898 was an exceptional year, because it had two maxima of wind velocity, one in March and one in October, instead of the usual single one in September. Some information that I had for Southampton seemed to indicate a similar state of things for rain in England (south) in that year. I had the monthly rainfall figures for England (south) computed for each year, and looked at once to those for 1898. Here are the figures for the two variables compared for that year.

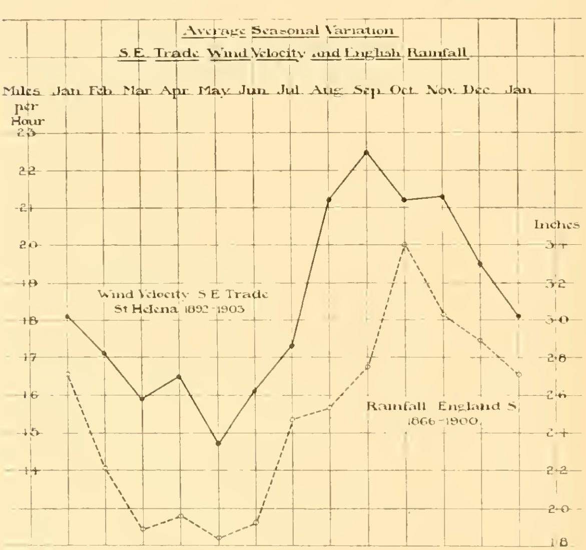


FIG. 1.

St. Helena wind velocity—

Miles per hour

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
19	19	22	20	19	16	16	15	22	24	20	20

South of England rainfall—

Inches

Jan.	Feb.	Mar.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0·71	1·58	1·12	1·39	3·59	1·46	0·49	1·37	0·99	3·48	3·67	2·86

There is unmistakably the second maximum of rainfall. It is in May, generally the driest month, two months after the unusual second maximum of wind velocity at St. Helena. The ordinary autumnal maximum of rainfall is delayed a month until November, just as the wind maximum is delayed a month until October.

As a test case this seemed to be almost conclusive and the connection to be put beyond doubt, but in meteorological matters there are many disappointments. Some goblin seems to be in possession of this castle in the air; we see a glimpse of light; knock at the door; the goblin opens it almost wide enough to let us in, and then he slams it in our faces with a laugh. One can almost hear the mischievous Puck crowing to the

"Captain of our fairy band,
Helena is here at hand,
And those things do best please me
That befall preposterously."

There is even a faint echo of the wicked exclamation

"Lord, what fools these mortals be!"

When one turns from the average of years to the individual years, after the curious test case of 1898 one must confess that while the seasonal variation is maintained fairly well in the trade wind, year by year, one cannot recognise it in the rainfall. There appears, perhaps it is hardly necessary to say so, to be no regular seasonal variation in a single year of English rainfall. Any month may be the wettest month or perhaps the driest, and so a fitful parallelism is rudely interrupted by a wet July or some unaccountable abnormality. The phenomenally wet year, 1903, is truly the year of greatest trade wind velocity, but the order of wind velocity is not regularly the order of rainfall values; one wonders whether the recorder has always been working as one would wish; and when the monthly rainfall average is taken for the twelve corresponding years instead of the thirty-five years, the curious

subsidiary maximum in April so neatly reproduced in the St. Helena wind has disappeared, owing principally, be it said, to an abnormally dry April in 1893.

Yet the evidence in favour of a connection can hardly be pure coincidence. The little rain maximum in April is not mere illusion. The fact that a seasonal variation of rainfall does show itself in the average of a few years has a meaning, and that its phases are closely similar to those of the arterial pulsations of the general atmospheric circulation accords too much with what may be called common sense to be altogether devoid of significance.

Sooner or later we shall catch the nimble imp that jeers at us to-day, and, if I mistake not, when he is caught we shall make him tell us something of the real secrets of these atmospheric relationships.

There are two considerations that may be mentioned. A disproportionately large fall of rain is sometimes regarded as an accident of little or no influence upon general meteorological conditions, but in view of the enormous quantities of energy involved that view can hardly be seriously maintained. It is true that on some days we get thunderstorms with heavy rain distributed in a most irregular manner, and for these at present no satisfactory explanation can be given, but it should be looked for seriously. Secondly, the rainy movements of the atmosphere in this part of the world are, as already mentioned, a south to north movement and a west to east movement. Perhaps we may in time be able to disentangle the effects of the various causes and find the regular sequence at present overlaid by the influence of secondary disturbing causes.

I have ventured to put forward these suggestions, which I frankly confess are deplorably bizarre, because my readers may have at their disposal methods, that I am ignorant of, by which a crucial test may be applied to the question whether there is any definite and, shall I say, useful connection between the pulsations of the south-east trade wind and the rainfall of north-western Europe.

W. N. SHAW.

TWO BOOKS ON ANIMAL BIOGRAPHY.[1]

IN the second of these two works the author expresses the opinion that the first question which will be asked by the reader is whether the various anecdotes are strictly true. The question that presents itself to our mind is whether such books will be read at all, and if so by whom? The professional naturalist, we dare venture to say, will have nothing to do with them; they are not apparently intended for children, and for our own part we confess that to read them for either pleasure or instruction is about the last thing we should think of doing. They are what may be called "animal novels," and thereby differ to a considerable extent from the old-fashioned "animal biographies," under which heading we have, however, ventured to include them. In each instance the author takes a number of more or less well-known animals, and recounts their ordinary everyday life, so far as it can be interpreted, Mr. English giving this for the most part in what are supposed to be the creature's own words, while the American author mingles verbal with descriptive narrative. Both works are, no doubt, excellent in their own particular way; and, for the sake of authors and publishers alike, we trust that a sufficient number of readers exist to whom this style of writing appeals with infinitely greater force than it does to ourselves. To such we may commend each of the two works, for, in the respective subjects, we find little to choose between them.

Mr. English, very appropriately, confines himself to British animals (including mammals, birds, fishes, insects, &c.); and although we cannot congratulate him on the title he has selected for his volume, we are pleased to be able to record our high appreciation of his skill as a photographer, and of the excellent manner in which his pictures have been reproduced.

FIG. 1.—The Wood-mouse. From English's "Beasties Courageous."

The photograph of the wood-mouse herewith presented to our readers is absolutely exquisite, and cannot be surpassed. Moreover, it is by no means a solitary example of excellence, every picture in the book being of high quality, although some are, of course, better than others. As a picture-book of various types of British animal life the book would be hard indeed to beat.

Mr. Long, on the other hand, takes for his subject some of the more striking animals of the Arctic districts of North America, which he calls for the most part by their native Indian names, after the manner of "Hiawatha."

The first six chapters are, for instance, devoted to the white wolf, under the title of "wayeeses, the strong one"; but it is a little remarkable to note that in the glossary at the end of the volume this name is spelt "wayeesis." Other chapters follow on the wild goose ("waptouk"), the fisher-marten ("pequam"), the salmon, &c. All bear the impress of truth, and relate the experiences of one who has seen the animals in their native wilds. The most striking incident is perhaps the one depicted on the cover of the book, where the author had the good fortune

[1] "Beasties Courageous; Studies of Animal Life and Character." By D. English. Pp. viii+121; illustrated. (London: Bousfield and Co., Ltd., 1905.) Price 5s. net.

"Northern Trails; some Studies of Animal Life in the Far North." By W. J. Long. Pp. xxv+390; illustrated. (Boston, U.S.A., and London: Ginn and Co.). Price 7s. 6d.

to see a wolf spring at night upon a jutting crag, where, silhouetted by the full moon behind, it gave vent to its "terrible howl." The illustrations in this volume are by that well-known artist Mr. C. Copeland, whose facile and truthful style stands in no need of any commendation of ours. These illustrations render Mr. Long's volume an attractive book for the drawing-room table at this season of the year.

SECONDARY SCHOOLS AND ENDOWMENTS.

AN INTERESTING TRANSFER SCHEME.

A SOMEWHAT novel proposal has been formulated for the transfer of an endowed school, with its property and funds, to an "education authority" other than a Local Education Authority under the Education Acts of 1902–3. This proposal relates to the Subordinate School at Rugby.

It appears that, for some time, there has been a movement in the locality with a view to the establishment of a technical school so as to organise systematically the scattered forces already at work. The Warwickshire County Council offered a grant of 1000*l.* towards the erection of such a school, while the governing body of Rugby School offered 500*l.* and a site on the grounds of the Subordinate School for the same purpose. These offers, however, failed to secure adequate local agreement—hence the above-mentioned transfer proposal.

According to the notice in the *London Gazette*, the governing body of Rugby School will apply to Parliament for an enabling Act "for the establishment, constitution and incorporation of an 'education authority,'" to whom that governing body may transfer the Subordinate School with its property and funds, and to whom they may make annual or other payments or contributions. This "education authority" would contain representatives of the governing body of Rugby School and of other local bodies (*e.g.* the County Council of Warwickshire, the Urban District Council of Rugby); any doubts or questions which might arise between the various bodies represented would be determined by the Board of Education. The "education authority" is to conduct the school "as a school for higher or secondary education . . . shall afford a good commercial education for students . . . and shall maintain the teaching of English, Latin, at least one modern foreign language and Greek, unless and until the governing body" (*i.e.* the governing body of Rugby School) "shall consent to the discontinuance of Greek." Other conditions relate to (1) the maintenance, by the governing body of the Rugby School, for the benefit of the students of the Subordinate School, of the existing system of major foundationerships at Rugby School; (2) the continuance of the engagements of the existing staff of the Subordinate School; (3) the borrowing, upon the security of the trust property, by the "education authority" of such sums for additions, improvements, &c., as may be needed—these powers to be subject to the conditions imposed by the Board of Education; (4) the maintenance at the Subordinate School, by the "education authority," of the existing system of foundationerships and scholarships tenable at that school.

A good deal of misgiving has been manifested locally in regard to the foregoing proposal, but it seems to us to be a step in the right direction. We confess that, as to nomenclature, the words "education authority" do not commend themselves to us as a suitable description of the new body to whom it is proposed to make the transfer. But the objects which may be secured under the proposal now foreshadowed are great indeed. To have obtained a gift which, if capitalised, would amount to between 50,000*l.* and 70,000*l.*, and to be enabled to utilise such resources to promote the educational and industrial progress of the town and neighbourhood of Rugby, are matters for sincere congratulation. The representative character of the new "education authority" will ensure the quickening of an intelligent interest in, and zeal for, that technical and higher education which the townsfolk of Rugby are seeking—including the actual provision of a technical school.

It is rather difficult to appraise rightly the action of those who have been disposed to reject an arrangement which, as we hope, is now about to be consummated. Possibly, upon reflection, they will become conscious, as has been the case with other erstwhile opponents, of the opportunities that are within their grasp. For this transfer provides not only that ladder which educationists are so anxious to erect for all those who can climb it, and who may thus be equipped for their several callings, but it will provide also an excellent object-lesson in regard to educational endowments and their administration for the public welfare. With potential issues like these, it is to be hoped that the inhabitants of Rugby and the neighbourhood will brace themselves for an effort in educational administration which shall inspire other localities to grapple earnestly with more exacting conditions.

NOTES.

LIEUT.-COLONEL PRAIN, I.M.S., F.R.S., took up the duties of director of the Royal Botanic Gardens, Kew, on December 16. Sir W. Thiselton-Dyer will continue to take charge of Government advisory work until March 31 next.

AT an Investiture held by the King on Monday, Prof. G. H. Darwin was invested with the insignia of a Knight Commander of the Order of the Bath (K.C.B.), and Sir Felix Semon with those of a Knight Commander of the Royal Victorian Order. His Majesty subsequently decorated the commander, officers, and several other members of the National Antarctic Expedition with the medal in commemoration of the expedition.

A SERIES of meetings for the informal discussion of important contributions to meteorological literature, particularly those by colonial or foreign meteorologists, has been arranged at the Meteorological Office by the director, Dr. W. N. Shaw, F.R.S. Two meetings have already been held, and seven others will be held from January to April of next year. The subjects suggested for discussion are of great interest to students and investigators of meteorological problems, and the director invites exchange of views upon them.

THE next meeting of the French Association for the Advancement of Science will be held at Lyons from August 2 to August 7, 1906, under the presidency of Prof. Lippmann.

WE regret to see the announcement that Mr. Lewis Wright, author of well known books on "Light" and "The Induction Coil in Practical Work," and of several works on the scientific breeding of poultry, was accidentally killed by a passing train at Saltford railway station, near Bristol, on Saturday, December 16.

A LARGE and influential committee of leading representatives of science in many parts of the world has been formed with the object of placing a monument to the

memory of the late Prof. Ernst Abbe at Jena between the Volkshaus erected by him and the optical works to the development of which he devoted his life. Zeiss instruments are in themselves monuments to Abbe's work wherever they are used, but there are probably many men of science who will welcome the opportunity of contributing to the establishment of some permanent representation of his personality in the place which he made famous. Subscriptions in support of the scheme should be sent to Dr. Gustav Fischer, Jena.

AMONG the letters from the honorary members of the Essex Field Club read at the meeting at Chingford on December 9 and referred to in our last issue (p. 157) was a very appreciative one from the veteran naturalist Dr. Alfred Russel Wallace, who had been attached to the club from the period of its foundation, and who had lectured at its meetings and taken part in many of the excursions and discussions. It is of interest to note that Dr. Wallace gave a preliminary account of his work on insular faunas and floras, being the substance of his book "Island Life," at a meeting of the club on January 4, 1881. In his recently published life he refers also to the fact that before his departure for America in 1886 he gave the club a lecture on the subject of variation, one of the chapters of his subsequent work on "Darwinism."

PROF. MELDOLA, F.R.S., presided over a "science dinner" given by the Maccabæans on December 16. After the loyal toasts, the chairman said the Maccabæans are a society composed primarily, though not entirely, of Jewish professional men, bound together by ties of race and religion. This race has contributed much to the advancement of philosophy and of science. It is the race which gave Maimonides and Spinosa to philosophy, the Herschels to astronomy, Ferdinand Cohn to botany, the Meyers and many others, including Brühl, to chemistry, and Lippmann and Herz to physics. Prof. Meldola concluded by giving the toast of "Science," coupled in the first place with the names of the representatives of scientific institutions represented in the room, and afterwards with individual representatives. Sir W. Huggins, F.R.S., and Sir A. Geikie, F.R.S., responded for the Royal Society, the Duke of Northumberland for the Royal Institution, Major P. A. MacMahon F.R.S., for the British Association, Mr. J. J. H. Teall, F.R.S, for the Geological Survey, Sir J. Evans, F.R.S., for anthropology, Sir Henry Roscoe, F.R.S., and Sir William Ramsay, K.C.B., F.R.S., for chemistry, Prof Poulton, F.R.S., for biology, Prof. Starling, F.R.S., for physiology, and Prof. Ayrton, F.R.S., for applied science.

SEVERAL subjects of scientific interest were discussed at the conference on smoke abatement and the exhibition of smoke-prevention apparatus held on December 13–15 in the hall of the Horticultural Society, Westminster. The inaugural address was to have been delivered by Sir Oliver Lodge, F.R.S., but he was prevented by indisposition from attending. Some manuscript notes by Sir Oliver Lodge were read to the meeting by Sir William Richmond. These notes dealt with fog as a destructive agent, and the proposal that smoke and fog should be precipitated by electrification of the air. The right way to deal with a town fog, according to the author, was not to produce it. The connection between fog and the imperfect combustion of solid fuel was then illustrated, and the need for improved methods of burning fuel insisted upon. At the same meeting the question, "Is London fog inevitable?" was discussed by Dr. W. N. Shaw, F.R.S. On the second day numerous papers were read, and of these may be mentioned stoking and smoke abatement, by Commander W. F. Caborne; the abatement of smoke in factories, by Dr. Rideal; the artificial production of persistent fog, by the Hon. Rollo Russell; destructive effects of smoke in relation to plant life, by Miss Agar and Mr. A. Rigg. At the third meeting of the conference Sir John Ure Primrose made a plea for a systematic analysis of the air of towns. He said that samples of the rainfall collected in Glasgow now show no traces of free acid, whereas only a few years ago similar samples were found to be strongly acid. This improvement in the city's atmosphere is due chiefly to the check the Alkali Acts have imposed upon the emission of acid gases by chemical and metallurgical works. The exhibition of smoke-abatement appliances included grates, stoves, cooking plant, heating flues, chimney construction, and smoke-consuming and smoke-preventing apparatus.

IN the note on the contents of the *Zeitschrift fur wissenschaftliche Zoologie*, vol. lxxx., part ii., published in our issue of December 7, Mr. S. Hlava's paper is stated to have been on the Radiata, instead of the Rotifera.

"THE Formation of Local Illustrative Collections in Museums" is the title of an article by Mr. J. Maclauchlan, of Dundee, in the October issue of the *Museums Journal*, which may be commended to the best attention of the governing bodies of provincial institutions of this nature, who, in many cases, are too apt to convert them into mere "curiosity-shops," or who attempt to usurp the functions of large museums by the display of a more or less ill-arranged general natural history collection. The rating of museums and public libraries is another question discussed in the same issue.

THE most interesting announcement in part iii. of the first volume of the *Journal of the Federated Malay States Museums* is, perhaps, the identification of a tooth of the Indian Pleistocene *Elephas namadicus* from Perak. Dr. C. W. Andrews being responsible for the determination, there can be no reasonable doubt as to its correctness; and this being so, the matter is of considerable interest as tending to link up the extinct proboscidean fauna of India and Burma with that of Borneo, Java, and Japan. In the same issue Mr. Bonhote describes a new rat, Mr. Ogilvie-Grant a new whistling-thrush, and Mr. H. C. Robinson a new tree-partridge, all from the Malay Peninsula or adjacent islands.

THE greater portion of the November issue of the *Quarterly Journal of Microscopical Science* is devoted to three instalments of a long paper on the formation of spicules, the author, Mr. W. Woodland, dealing in this instance with calcareous sponges, Alcyonium, and the sea-urchin larva. The relation of triradiate spicules to the dermal cells to which they owe their origin is beautifully illustrated in the plates, and it is shown that, as in the case of the simpler types, the triradiate form is directly related to the conformation of the secreting agency. As to the use of these triradiate spicules, it is pointed out that the hollow cylinders of which sycon-sponges consist are liable to be swayed by the movements of the water, and that were these oscillations to become excessive the organism would be injured. Moreover, as the oscillations are both vertical and horizontal, support in each of these directions is essential. "Both of these elements are supplied by the numerous triradiate spicules contained within the sponge-wall, for it invariably follows from their conformation that if one ray be vertically disposed, then the two companion rays will lie in lines only deviating from the horizontal

by an inclination of 30°, and hence the three rays practically constitute two axes, respectively lying in the required vertical and horizontal directions." It will be remembered that in a recent note we referred to the views of an author who regarded these triradiate spicules as an instance of over-specialisation.

THE *Journal of Economic Biology* is the title of a new serial, edited by Mr. W. E. Collinge, and published by Messrs. Dulau and Co. For some time, and more especially since the foundation of the Association of Economic Biologists, it has been evident that workers in the subject to which the new serial is devoted frequently experience difficulty in finding suitable means of making their labours known to the public, especially when illustrations to their papers are required, and it is to meet this want that the venture, to which we wish cordial success, has been made. In the opening article Prof. A. H. R. Buller discusses the destruction of wood-paving in roadways by a kind of dry-rot produced by the fungus known as *Lentinus lepideus*. In the second article the editor describes some very remarkable varieties of the currant-moth produced by change of food and temperature, while in the third and last communication Mr. F. V. Theobald describes new gnats from various parts of the world.

WITH the October issue the publication of *Climate* came to an end, an amalgamation having been effected with the *Journal of Tropical Medicine*, which in future will devote four of its issues annually to the special subjects hitherto dealt with in *Climate*.

THE *Journal of the Royal Sanitary Institute* for December (xxvi., No. 11) contains the second part of a paper on the administration of the Food and Drugs Acts by Mr. Wellesley Harris which should be very useful to students of public health, the mortality statistics of boot and shoe workers in Northampton by Dr. Beatty, a note on the recent literature of plague by Colonel Notter, and an article on school hygiene by Dr. Elkington.

IN an interesting article on the revival of phrenology in the *Fortnightly Review* for December, Mr. Stephen Paget reviews the subject and refers to Dr. Bernard Höllander's book on the mental functions of the brain. Gall it was, celebrated for his anatomical studies of the brain, who originated what is known as phrenology, a study very different from the present conception of localisation of function in the brain, as Mr. Paget points out. From the wreck of Gall's work Dr. Höllander has saved many well recorded cases of localised injury or disease of the brain with exaggeration or diminution of this or that one function—cases such as led to the discovery of the speech centres. But when Dr. Höllander asserts that his book may have an important bearing on the development of mental science, on the treatment of lunacy, &c., Mr. Paget considers that he is claiming much more than can be admitted.

ON the subject of the conditions essential to the best production of Para rubber, Mr. H. Wright has compiled some useful data in vol. iii., No. 6, of the Circulars of the Royal Botanic Gardens, Ceylon. It would appear that richness of soil is not so important as altitude and temperature, since by the annual shedding of its leaves the tree returns a large amount of material to the soil. With regard to temperature, the trees thrive best in Brazil in a mean temperature about 25° C., while, as to altitude, the limit of successful cultivation in Ceylon is placed at 2000 feet above sea-level.

THE superintendent of the botanical department, Trinidad, in the Bulletin (October) refers to a new variety of coffee, *Coffea robusta*, received from the Congo River, West Africa, that has been successfully propagated at the experiment station. A stock of nearly two thousand plants offered for distribution was quickly disposed of to planters. In the same journal Mr. W. R. Buttenshaw, writing on the subject of selection by means of vegetative propagation, instances a few of the improvements that have been effected by continuous selection of cuttings and by bud selection. A distinction is drawn between the sudden emergence of a sport and gradual development by careful selection.

WITH the object of ascertaining whether a commercial fibre can be prepared from banana leaf-sheaths, it is announced in the *Agricultural News* (October 21) that prizes for the best samples of fibre will be offered at the agricultural show to be held in the course of this month in Barbados; the fibre will be extracted from the dwarf banana, as this is the species cultivated there. In the last number of the journal, which, owing to an alteration in the sailings of the Royal Mail steamers, is dated November 11, a note appears on the cigarette and biscuit beetles. The former, *Lasioderma serricorne*, does not confine itself to tobacco, but feeds also on leather and drugs, and the biscuit beetle, *Sitodrepa panicea*, shows similar tastes.

THE report for the year 1904 of the director of the botanic gardens in Sydney, New South Wales, has been received. Amongst the list of interesting plants that have flowered during the year are *Diplachne Peacockii*, an indigenous grass recently discovered, *Paspalum cochinchinense*, another grass that, judging from the vigorous growth made in a dry season, may prove as valuable for fodder as *Paspalum dilatatum*, *Eucommia ulmoides*, the Chinese rubber-tree, and a number of Opuntias that are being cultivated with the object of obtaining a spineless plant. Of the trees planted in the Centennial Park, the most interesting are the Aleppo pines, *Pinus halepensis*, that are being grown as a wind-break.

IN the *Engineer* of December 15 drawings are given of a dredger that has been used by the Dundee Harbour Trustees for more than a century. It is built of oak, and is 68 feet long with a beam of 21 feet, and draws in working order 7 feet 6 inches. The engine is believed to have been built by James Watt.

IN the December number of the *Popular Science Monthly* there is a useful article by Prof. R. D. George, of the University of Colorado, giving an able summary of the existing knowledge of mining and the use of metals by the ancient Egyptians. In the same issue Dr. Charles R. Eastman, of Harvard University, inquires into the rightfulness of regarding Anaximander, the pupil of Thales in the sixth century B.C., as the first who foreshadowed modern ideas of evolution. All estimates present Anaximander as a keen and deeply contemplative student of nature who arrived at a dim adumbration of great truths.

IN the current issue of the *Bulletin de la Société d'Encouragement* Messrs. G. Arth and P. Lejeune give some interesting particulars of a prehistoric mass of metal found near Nancy at a depth of $4\frac{1}{2}$ metres below the surface. The mass weighs about 300 kilograms, and is accompanied by fragments of charcoal and slag. It appears

to have been the base of an ancient hearth in which the metal had been subjected to repeated and prolonged heatings. The metal contains, in addition to iron, 1·212 per cent. of combined carbon, 0·038 per cent. of graphite, 1·670 per cent. of silicon, 0·026 per cent. of sulphur, 0·013 per cent. of phosphorus, and 0·180 per cent. of manganese. It is thus a steel containing a higher percentage of silicon than is now usual. The microscopic examination shows that it belongs to Guillet's first group of silicon steels, pearlite steels consisting of a solid solution of Fe_2S in iron. In the same issue Mr. A. Porlier gives details of the composition of a cast-iron cannon ball found in making the underground railway through the old moat of the Bastille. The cannon ball was absolutely compact, but oxidised throughout, its specific gravity being 4·854 instead of 7·6 as is usual for cast-iron. Under the microscope the cementite appeared in brilliant lines, showing that it had completely preserved its metallic state. The oxidised portions, appearing as black masses, were derived from the pearlite, which in admixture with cementite constitutes ordinary white pig-iron. Analysis yielded:—water, 2·9 per cent.; carbon, 5·9 per cent.; silicon, 0·25 per cent.; manganese, 0·75 per cent.; iron, 72·0 per cent.; and oxygen, 17·45 per cent. The complete oxidation of the cannon ball, without any exterior deformation or fissuration, shows the intense action of diffusion during a century, and enables us to understand how the changes of rocks by metamorphism have been able, thanks to the intervention of infinitely longer periods, to give rise to new rocks of a homogeneous structure.

IN No. 50 of the *Bulletin du Musée océanographique de Monaco* Prof. H. Hergesell gives an interesting account of the method employed by the Prince of Monaco in the North Atlantic last April for ascertaining the conditions of the upper air by means of unmanned balloons sent up from his yacht. Two closed india-rubber balloons were employed; at a certain altitude the upper balloon bursts, or is set free by a simple electrical arrangement, when the lower one, which carries the recording instruments, falls, but has a float attached to it, at about 50 metres below it, and when this reaches the surface of the ocean the balloon is carried along by the wind at a height of 50 metres, and then the yacht has to chase it at full speed. Out of five cases specified by Dr. Hergesell, only one of the balloons eluded the pursuers. Of course, such a procedure can only be undertaken by a vessel having no other object in view, and it is necessary that the air should be clear, and that the velocity of the wind should not exceed the speed of the ship. Such experiments are exciting, but expensive; but some useful results at high altitudes were obtained.

A REMARKABLE dam is under construction at Niagara Falls, where the commissioners of Victoria Park, on the Canadian side of the river, have erected a column of concrete 50 feet high and 7 feet 4 inches square. This column of concrete was built on a trestle that stands 20 feet above the ground-level, and after the material is thoroughly dry the column is to be tipped over into the river to form a dam. The necessity for this work arose from the fact that the City of Niagara Falls, Ontario, and the Niagara Falls Park and River Railway, made complaint to the park commissioners that the works of construction for power development had lowered the water in the joint intake. The approximate weight of the concrete column is 200 tons. Every 8 feet of its height a wooden wedge is inserted in the side, and passes nearly to the centre, each wedge being about 12 inches thick on the outside, tapering to about 6 inches near the centre. The object of these wedges is to break the column into six pieces when it is tipped over. However, these sections will not be allowed to be caught by the current, for running up through the centre of the column there is a very heavy chain, the weight of which is about 800 lb. The purpose of this chain is to hold the sections together when the column is broken in falling. When it is prostrate, the top of the column will be 20 inches above the ground-level, and is expected to raise the water in the intake considerably. The intake is only about 600 feet up from the brink of the Horseshoe Fall, but the dam

FIG. 1.—A column of concrete built to be tipped over to form a dam at Niagara Falls.

will not affect the flow of the waterfall at that point. When dry, the column will be tipped by operating jacks under the base of the trestle, and when it tumbles it is expected to fall a little up-stream.

WE have received from Messrs. R. and J. Beck, Ltd., a copy of their new illustrated price-list of telescopes. The list contains particulars of numerous astronomical and naval telescopes, object glasses, spectroscopes, transit instruments, small observatories, diffraction gratings, &c., and will be found to be very useful and suggestive to any amateur astronomer who wishes to add a good instrument to his equipment; some of the portable mountings, both equatorial and altazimuth, appear to be very compact and useful. A copy of a photograph of the iron spectrum, taken with a "Thorp" transmission grating, shows the suitability of these replicas for high-class work, and Messrs. Beck undertake to mount the grating copies either on parallel plate glass or on prisms of any desired angle. All kinds of surveyors' instruments are also quoted in this list.

THE results of an interesting research on the selective reflection, by various crystals, in the infra-red spectrum are published by Mr. J. T. Porter, of Johns Hopkins University, in the November number of the *Astrophysical Journal*. It has previously been shown by Prof. E. F. Nichols that in the neighbourhood of $8 \cdot 5\,\mu$ the reflection from quartz is twenty or thirty times greater than in other parts of the spectrum, so that after three reflections from such a surface the spectrum practically contains only radiations of that wave-length. The wave-lengths of the "Reststrahlen," or the rays remaining after reflection, have already been determined for seven other substances by previous workers, and Mr. Porter examined fourteen additional crystalline compounds and found that at least seven of them exhibited unmistakable maxima in various parts of the spectrum. The radiometer and the method employed are fully described and illustrated in his paper, which also shows the energy curves of the spectra of the reflected radiations. The list given for nine of the substances tested shows that the wave-lengths of their "Reststrahlen" vary from $2 \cdot 30\,\mu$ for copper sulphate to $10 \cdot 31\,\mu$ for potassium dichromate.

MESSRS. WHITTAKER AND CO. have published a third edition of Mr. Joseph Poole's "Practical Telephone Handbook." The new edition has been entirely re-written and greatly enlarged.

WE have received from the superintendent of Government printing in India two volumes of the agricultural statistics of India for the years 1899–1900 to 1903–1904. The statistics have been compiled in the office of the Director-General of Commercial Intelligence. The first volume is concerned with British India, and the second with the native States. The volumes will prove of value to statisticians interested in Indian agriculture.

"WHO'S WHO" and the "Who's Who Year-book" for 1906 have now been issued by Messrs. A. and C. Black. "Who's Who" is a familiar work of reference everywhere; its price remains the same, 7*s*. 6*d*. net, but the volume has been enlarged by the addition of eighty-two pages. Interesting additions are made this year to many of the biographies by a record of the number of a person's sons and daughters. Motor and telephone numbers and telegraphic addresses have been added where requisite. The biographical notices of Fellows of the Royal Society and other men of science contained in the volume are of particular interest to us. This indispensable reference book is admirably supplemented by the year-book with its conveniently arranged tables, among which are to be found lists of the learned societies and university professors.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A THIRD NEW COMET, 1905*d*.—A telegram from the Kiel Centralstelle announces the discovery of yet another new comet. Apparently the proximity of this object was discovered from the appearance of its image on a photographic plate exposed on November 29, and examined subsequently. The discovery was made by Mr. Slipher at the Flagstaff (Lowell) Observatory, and the position of the comet on November 29d. 9h. 27m. (Flagstaff M.T.) was found to be

R.A. = 22h. 44m., dec. = $11^\circ\ 18'$ S.

This is situated in the constellation Aquarius, about half-way between λ and τ Aquarii.

The daily movement in R.A. is given as $-1^\circ\ 33'$, or 6m. 12s., and in declination as $+25'$. From this it will be seen that the comet was at that time travelling in the direction of the constellation Aquila.

COMETS 1905*b* AND 1905*c*.—An observation of comet 1905*b*, made by Prof. E. Millosevich on December 13, gave corrections of -2s. and $-2' \cdot 3$ to the ephemeris published in No. 4057 of the *Astronomische Nachrichten*. The observed magnitude was 11·5.

The following set of elements for the orbit of comet 1905*c* have been computed by the discoverer, M. Giacobini, and, together with an ephemeris, from which an extract is given below, is published in the *Comptes rendus* for December 11:—

T = 1906 January 31·620 (Paris).

$$\left.\begin{aligned} \omega &= 171^\circ\ 23' \cdot 7 \\ \Omega &= 89\ \ 42 \cdot 0 \\ i &= 42\ \ 44 \cdot 3 \end{aligned}\right\} 1905 \cdot 0$$

$$\log q = \bar{1} \cdot 72728$$

Ephemeris 12h. (M.T. Paris).

1905	α (h. m. s.)		δ (° ′)		log Δ		Brightness
Dec. 22 ...	15 41 51	...	+12 27·3	...	0·1251	..	2 04
,, 26 ...	16 3 49	...	+ 9 44·0	...	0·1153	...	2·45

THE RECENT AURORA AND MAGNETIC DISTURBANCES.—From an account published in the current number of the *Observatory*, we learn that on November 15, the date of the recent great display of the aurora, the greatest disturbance of the Greenwich magnets which has been recorded during the present year took place. All three elements were affected, a deflection of about 40′ being recorded by the declination-needle at 9 p.m. Of the two considerable streams of sun-spots which appeared near to the place of the great October spot (October 14–27), the one was a little ahead of the central meridian and the other not quite up to it at the time of the disturbance.

PHOTOGRAPHS OF JUPITER'S SIXTH AND SEVENTH SATELLITES.—At the meeting of the Royal Astronomical Society held on November 10, the Astronomer Royal exhibited and explained some photographs of the sixth and seventh satellites of Jupiter, obtained with the 30-inch reflector of the Thompson equatorial at Greenwich.

The results of the provisional measures of the photographs, and their comparison with the angles and distances given by Dr. Ross's ephemeris, the dates, and the exposures are given in No. 1, vol. lxvi., of the *Monthly Notices*. The exposures for the seventh satellite varied from 17 minutes to 177 minutes.

THE INTRINSIC LIGHT OF THE CORONA.—Employing a modified "Mascart" photometer, M. Chas. Fabry determined the relative brightness of the intrinsic light of the corona during the recent total eclipse of the sun. As a result, he found that at a distance of 5′ from the edge of the sun, and in the neighbourhood of the solar equator, the light of the corona has an intrinsic value of about 720 candle-power. Comparing this with the mean intrinsic value of the light of the full moon (viz. 2600 candles), he obtains the ratio 0·28 : 1, a value which confirms Prof. Turner's ratio of 0·25. To illustrate the great difficulty which attends the photographing of the corona in full sunlight, M. Fabry compares the value he thus obtained with the accepted value for the brightness of the sky near to the sun, and arrives at the conclusion that even the most brilliant parts of the corona are probably some 2000 times less bright than the sky on which they are projected (*Comptes rendus*, No. 23).

SUGGESTED NAME FOR NEPTUNE'S SATELLITE.—Writing to the *Observatory*, M. Fouche suggests that Neptune's satellite should be named after the most renowned of Neptune's sons, *i.e.* Triton. He states that this name has already been used for designating the satellite by several well known astronomers.

THE "COMPANION TO THE OBSERVATORY," 1906.—As in former years, the well known "Companion to the Observatory," published by Messrs. Taylor and Francis at 1*s*. 6*d*., contains all the data that an ordinary astronomer is likely to require in the briefest and handiest form. Messrs. Denning, Maw, and Lœwy have again provided the data referring to "Meteor Radiants," "Double Stars," and "Variable-star Ephemerides" respectively, and Dr. F. E. Ross's ephemeris for Jupiter's sixth satellite is given amongst the other tables which deal with the satellites of the major planets.

HYDROLOGY IN THE UNITED STATES.

WE have referred on previous occasions to the very complete way in which hydrological research is carried out in the United States, and to the value of the reports that are made from time to time by the officers having charge of the works.[1] We have been favoured with twenty-five further reports recently issued. The greater part of these refer to the water resources, and to the surveys being carried out by the departments in the different States. These are principally of local interest, although they contain a great deal of information useful to those engaged in water supply. Some of these reports, however, relate to matters that are of more general interest.[2]

Paper 119 contains an index to the hydrographic progress reports, 1888–1903, and paper 120 a review and index to papers relating to underground waters published by the United States Geological Survey, 1879–1904.

Report No. 110, on the hydrology of the eastern United States, contains twenty-three short papers by nineteen geologists and physicists connected with the eastern section of this division of hydrology. The most interesting of these papers is that which relates to the methods used in measuring the velocity, direction, and quality of underground water.

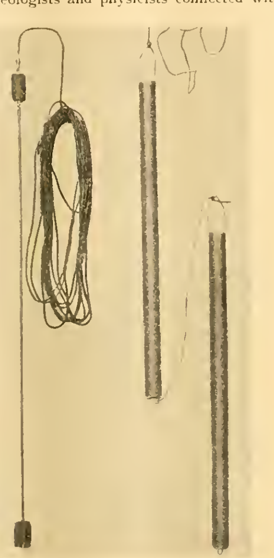


FIG. 1.—Electrode and perforated brass buckets used in charging wells.

The Discharge of Sewage into Porous Strata.—In one of the papers, by S. W. Callie, is recorded the experiments made to ascertain what would be the effect of discharging town sewage into pervious strata on the water supply of the neighbourhood drawn from wells.

The town of Quitman derives its water supply from a well in the limestone at a depth of 123 feet from the surface. A section of the soil shows 2 feet of surface sand, 60 feet of clay, 15 feet of sand, and 43 feet of water-bearing limestone.

The authorities of the town were seriously considering the question of disposing of the town's sewage by means of deep wells into the porous strata. The writer of the paper was engaged to report as to what effect this would have on the water supply. For this purpose he adopted the chlorine process. Seven wells in the locality were selected for making the experiment, the water in which was found to stand at a lower level than that in which the chlorine was to be introduced. Samples were taken from these wells, and the normal amount of chlorine determined. Two tons of salt were then put into the test well in the form of solution during a period of five days. Special precautions were taken in the method of introducing the salt to ensure complete saturation of the water. The normal chlorine at the well from which the water supply for the town was drawn was 5·44 parts in a million. Four hours after the introduction of the salt in the test well the chlorine began to increase, reaching a maximum of 6·80 parts in twelve hours, and continued to show an excess during the five days, after which it

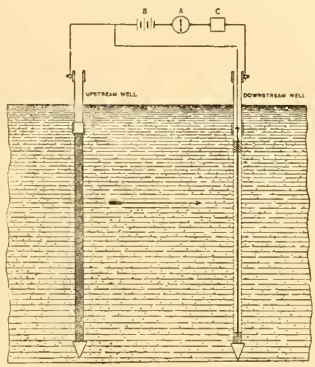


FIG. 2.—Diagram illustrating electrical method of determining the velocity of flow of ground water. The ground water is supposed to be moving in the direction of the arrow. The up-stream well is charged with an electrolyte. The gradual motion of the ground water toward the lower well and its final arrival at that well are registered by the ammeter A. B is the battery, and C a commutator clock which is used if A is a recording ammeter.

gradually subsided to its normal quantity. At two of the other wells a similar excess of chlorine was found, but at the other wells no change in the character of the water took place.

The general conclusion arrived at was that if sewage were discharged into the water-bearing strata it would contaminate all the wells in the locality that had a depth of 120 feet or more, and that if the proposed scheme of the municipality had been carried out it would probably have resulted in a serious epidemic.

Measurement of Underground Currents.—A paper by Charles S. Slichter gives a description of the underflow meter used in measuring the velocity and direction of underground water.

For the purpose of measuring the underground flow in any locality test wells are sunk consisting of 1½-inch or 2-inch tubes. These pipes are in lengths of 6 feet or 7 feet, with long threads and heavy wrought nipples. The well points are 4-feet brass jacket points of wire gauze. The tubes are driven with a ram weighing from 150 lb. to 250 lb., the movement of the tube being aided by a water jet. Four wells were driven from 4 feet to 6 feet apart in a triangular form, one at the apex and the other three at the base of the triangle. The deeper the wells the greater the distance apart at which they were placed.

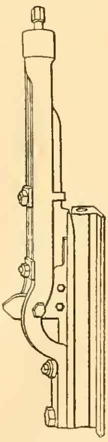


FIG. 3.—Perforator for slitting well pipes.

The up-stream well is charged with a strong electrolyte such as sal ammoniac, which passes down stream with the underground water to the lower wells (Fig. 1). Each of the down-stream wells contains within the well point an electrode consisting of a nickel brass rod ⅜-inch thick by 4 feet long, insulated from the casing by wooden spools. This electrode communicates with the surface by means of rubber-covered copper wire, and connects with a recording ammeter. As the electrolyte reaches one of the down-stream wells its appearance is at once recorded by the

[1] "Water Supply and Irrigation in the United States" (NATURE, January 7, 1904); "Relation of Rainfall to Run Off" (July 28, 1904); "Floods in the Mississippi Valley" (November 3, 1904); "Hydrology in the United States" (December 22, 1904).

[2] "Water Supply and Irrigation Papers," Nos. 99 to 132. (Washington: Government Printing Office, 1904–5.)

meter, the time occupied in passing from the upper to the lower well being thus found, and giving the rate of flow of the water.

Further details of observations of underground flow as carried out by this method are given in paper No. 112, by Homer Hamlin, with numerous illustrations of the apparatus used.

Stove-pipe Wells.—In the same report is a paper by Charles S. Slichter on the method of sinking stove-pipe wells. These consist of a riveted sheet steel starter from 15 feet to 25 feet long, made of two or three thicknesses of sheet steel with a forged steel shoe at the lower end. The rest of the casing consists of two thicknesses of sheet steel made into riveted lengths of 2 feet, one set of sections being made just so much smaller than the other as to permit them to telescope together. Each outside section overlaps the inside section 1 foot. This casing is sunk, length by length, by hydraulic jacks, which press on the upper sections by means of a suitable head. After the well has been sunk to the required depth, a cutting knife is lowered into the well and vertical slits are cut in the casing opposite such water-bearing strata as may have been met with; a well 500 feet deep may have 400 feet of screen if circumstances justify it. The perforator is handled with 3-inch pipe. By raising slowly on the line with hydraulic jacks, cuts are made from three-eighths to three-fourths of an inch wide, and from 6 to 12 inches long.

The well casings vary in diameter from 17 inches to 14 inches, and are sunk to depths from 500 feet to 1400 feet, the yield of water varying from 300,000 to 3,000,000 gallons in twenty-four hours. The cost of a 12-inch 500 feet well is about 140*l.* for labour and 100*l.* for materials, the drillers being paid 1*l.* and the labourers 10*s.* a day. The soil where these wells are in use consists of mountain débris, clay, gravel, sand, and boulder.

Pollution of Streams by Waste from Factories.—Paper No. 103 contains a review of the laws in operation in the different States of America for the prevention of pollution of inland waters. The broad legal principles under which anti-pollution statutes become operative are explained, and important Court decisions are quoted to show the authority upon which certain deductions in the report are founded.

In paper No. 133 the special stream pollution arising from the refuse water from the "straw board" factories is dealt with. In Indiana, Ohio, and Illinois there are several large factories engaged in making pasteboard from rye, wheat, and oat straw. For this process 40,000 gallons of water are required to wash 1 ton of straw, and 3200 lb. of straw and 560 lb. of lime are required to make 2000 lb. of board. In an ordinary factory 2,000,000 gallons of water are used daily, which carries with it 19 tons of straw waste and 10 tons of lime. This waste generally runs into a neighbouring stream, and is the cause of a serious amount of pollution. The report of the Government Commissioner for Fisheries states that the pollution of the streams in Indiana by the refuse from the strawboard mills, oil mills, and pulp mills is greater than from any other source. The refuse from these covers the spawning beds and prevents the eggs from hatching, while it penetrates the gills of the living fish and either kills or drives them away from the streams.

The remedy is by chemical precipitation of the waste products, but it is contended that the small profit on the manufacture of strawboard does not permit of the application of the process required.

Another source of water pollution dealt with in this report arises from the overflow from the oil wells in Indiana. Around the city of Marion there are no less than seventy-five oil wells in a few square miles of territory. Upwards of 300 surface and rock wells in this area are suffering contamination from this source. The strata in this district consists of sand and gravel for about 50 feet, then clay for about 80 feet, and below this limestone. The water supply of the town and neighbourhood is derived from water in the limestone, and there is a constant flow of underground water. Oil occurs near the top of the formation. Beneath the oil is salt water. In order to form a reservoir for the oil the limestone is entered some distance, and the most successful wells are those which are drilled deep enough to allow a large amount of oil to collect, so as to be above the upper level of the brine. These oil wells are generally 1000 feet deep, the oil rising to within 600 feet or 700 feet of the surface. When the well is bored it is "shot" with nitroglycerin, which breaks up the limestone and forms fissures and small cavities which act as reservoirs into which the oil flows. The surface effect of the shooting is the violent ejection of salt water and oil, often to the extent of thousands of gallons. The oil and salt water then sink into the soil where it is porous, and finally reach the surface zone of underground flow, where they partake of the general movement of the water toward the main line of underground drainage, and cause its pollution. The brine and oil pumped from these oil wells is discharged into a settling tank. The oil, owing to its lighter specific gravity, settles at the top and is drawn off, the brine being discharged into any neighbouring creek or stream, or is allowed to sink slowly into the ground, in either case becoming a serious source of pollution to the water supply of the neighbourhood.

Paper No. 121 relates to the pollution of Lake Champlain, by M. O. Leighton. The report was made in consequence of complaints made to the Government that the water of the lake has been rendered unfit for domestic consumption; that the usefulness of the lake for watering cattle has been destroyed; and that the refuse poured into it is destructive to fish life. The cause of pollution is due to the waste discharged into it from the pulp mills situated on its banks. The analysis of the water and other details are interesting to those who have to deal with the making of pulp and similar industries.

Paper No. 122 is entitled "Relation of the Law to Underground Waters," by D. W. Johnson, and contains an outline of the main features of the laws respecting underground waters with the object of giving to the owner of such waters some idea of his rights and obligations concerning them. Such legal decisions as serve to show the relation of the law to the problems which are essentially geological in character are referred to. Underground waters are defined and classified. Although this paper refers to United States practice, there is a great deal of information that would be of service to water engineers in this country. We shall refer more fully to this paper in a future number.

THE PERCY SLADEN EXPEDITION IN H.M.S. "SEALARK" TO THE INDIAN OCEAN.

I HAVE just received the following interesting communication from Mr. Stanley Gardiner. It was written from Port Victoria, Seychelles, under date October 28, and is the fourth report of his expedition which he has sent home. Mr. Gardiner is expected home early in the New Year. For his earlier reports, see NATURE, August 10, October 5, and November 9. A. SEDGWICK.

Cambridge, December 1.

During the ten days that the *Sealark* left us at Coetivy while she was coaling in the Seychelles, we as thoroughly as possible collected the animals and plants of both the land and reef. The island was higher than any we had up to that time visited, having wind-blown sand ridges and hills up to 80 feet above sea-level, arising on a flat coral reef. Although situated only about 130 miles to the south of the Seychelles Islands, the land fauna and flora are almost the same as on the islands of the Chagos Archipelago, being scarcely richer in either. The plants, of course, in the main necessarily govern the fauna, and it would appear to us that they are in their turn governed rather by the nature of the soil—coral and coral sand—than by their proximity to continental land. On the other hand, the reefs of Coetivy showed in every group of marine animals a more varied fauna than those of the Chagos, while very nearly all the species of the latter seemed to be present. The reef on the eastern, or seaward, face of the island was of a rather different character from any we had as yet seen (or from any I have seen in the Pacific), being covered with a grass-like weed, locally termed "varech." There was also on the same part a

considerable variety of other algæ, but the edge and outer slope were, as elsewhere, covered by corals and nullipores. The reef, however, to the west, where there is a flat extending out for some miles with about 16 fathoms of water, closely resembled similarly situated reefs in the Chagos, but the greater variety of its organisms was equally marked, though individual species were much less common.

Leaving Coetivy on September 25, we proceeded to a point about midway between Madagascar and Farquhar Atoll, both to ascertain the depth and the compass variation. The latter was almost the same as at Mauritius, situated 9 degrees to the south, while the depth, 1856 fathoms, precludes the idea of any close connection between the two localities. Farquhar, which we then visited, was (as, indeed, were all the reefs we subsequently saw) remarkable for its almost completely covered "varech" reefs, both rim and lagoon. Its land attains a height of more than 70 feet, and is clearly of the same formation as that of Coetivy; it shows no trace of elevation, and it has not been formed, as has been stated, by submarine deposits. The section of the reef also showed the outer slope to be quite similar to that of other atolls.

From Farquhar we proceeded to sound between the chain of islands that extends between Madagascar and the Seychelles, and which would appear to indicate a line of former connection. Between Farquhar and Providence, 32 miles, we found 890 fathoms, and between the latter and Alphonse-François, 155 miles, 2170 fathoms, while there were already soundings of 952 fathoms between Alphonse and the Amirante Group, 46 miles, and of 1150 fathoms between the latter and the Seychelles, 32 miles. As the depth on either side is only about 2300 fathoms, any connecting ridge is comparatively low and of doubtful importance.

Providence was particularly interesting, being simply a great reef, 28 miles long by 7 miles broad to the 100-fathom lines. Off it we took twelve dredgings, obtaining a rich fauna down to about 100 fathoms, below which the bottom was exceedingly barren of life. From one dredging at 744 fathoms, 3 miles to the west of the reef, we obtained about 5 cwt. of stones, the largest about 2 feet in diameter. We have here no means of properly ascertaining their nature, but similar rock has not, so far as we are aware, been hitherto described off any coral reef. It is almost entirely insoluble in acids, and is largely formed of different crystals, organic deposits practically not entering into its composition. Some masses looked like solidified ash or clay, while others *appeared* rather like volcanic bombs. All were more or less coated with manganese, but we do not know its thickness, preferring to keep the specimens intact for proper examination on our return to England. However, it is clear that the existence of this rock in such a position will have to be carefully considered in connection both with the formation of Providence Reef and with the existence of any former land connection between the Seychelles plateau and Madagascar.

Pierre Island, 17 miles to the west of Providence Reef, and with a depth of 1088 fathoms between, is peculiar in having no fringing reef. It is simply an elevated coral island, reaching to a height at present of about 30 feet, surrounded by overhanging cliffs, so that landing is extremely difficult. Its rock is entirely coral.

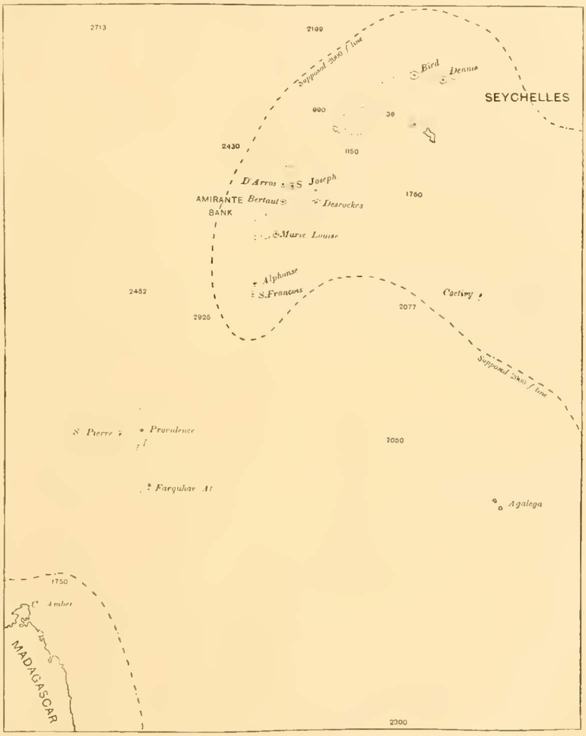


Fig. 1.—Chart of the Indian Ocean between Madagascar and the Seychelles.

Alphonse and François are sandbanks on the rims of two reefs, scarcely 2 miles apart. Both reefs are of atoll formation, the lagoon of Alphonse (not shown in any chart) being 3 to 8 fathoms deep and of considerable size.

The Amirante Islands are likewise sandbanks, no parts of any being more than 10 feet above the high-tide level. The hills represented in the separate enlarged plans of D'Arros, St. Joseph, and Desroches do not exist, and probably owe their presence thereon to the imagination of the draughtsman.[1] Desroches is really an atoll by itself, lying 10 miles to the east, and being separated by a channel 874 fathoms deep. The rest of the islands and reefs lie on a bank about 50 miles long by 20 miles broad, with an average depth of about 30 fathoms. Eleven separate reefs reach the surface, of which St. Joseph alone has a lagoon, being really a small atoll with about 4 fathoms of water in the centre. With the exception of Eagle, D'Arros, and Bertant, all the reefs lie on the edge of the bank, but its edge is in most places covered by at least 8 to 10 fathoms of water. Its slope is steeper than is customary off coral reefs, no possible dredging ground existing between 60 and 500 fathoms.

All the islands of the Amirante Group, with the exception of Marie-Louise and Eagle, are now planted for cocoanut oil, but the indigenous vegetation still remains in places. The land plants and animals are almost the same as at Coetivy and in the Chagos, the additions due to the

[1] If we had had any idea of this earlier, we should have probably visited Cosmoledo and perhaps Aldabra.

proximity of Africa and the Seychelles being relatively few. The marine fauna and flora was markedly richer than even at Coetivy.

Of other work, we have taken about sixty dredgings off the islands we visited down to more than 800 fathoms, and tow-nettings at various depths to more than 1000 fathoms. We have consequently rich collections, but obviously no estimate of them can be at present formed. We have also serial temperatures in a series of positions, and water samples have been taken throughout down to various depths. Magnetic observations have also been secured at intervals along the line between Madagascar and the Seychelles.

As we are now leaving H.M.S. *Sealark*, I would like to express our great indebtedness to Commander Boyle T. Somerville and every officer and man on board for their great kindness and most cheerfully rendered assistance to Mr. Forster Cooper and myself. Nothing has seemed too great or intricate or small for them to undertake, from a complicated survey to the repair of delicate instruments or dredges. The weather throughout the voyage—the season chosen was governed by considerations relating to hurricanes—has been, generally speaking, most unsuitable and unpleasant, but work has nevertheless gone on almost continuously. All regular survey work, sections across the islands, soundings, magnetic, tidal and temperature observations, &c., have been done by Commander Somerville and his officers. Mr. Beer, the artificer engineer in charge, and his staff have been indefatigable in eking out the coal, on which our movements necessarily depended to a large degree, and in effecting the not inconsiderable repairs connected with such a long cruise away from regular ports. The artificers (carpenter, blacksmith, and armourer) have never failed over the varied and unusual work which they have at times been called upon to undertake, and, finally, every individual hand has been splendid in giving of his very best to assist the expedition to success.

J. STANLEY GARDINER.

FORESTRY IN BELGIUM.

THE Royal English Arboricultural Society paid a visit to the Belgian forests on August 12–22. The Belgians, like ourselves and all other European countries, except Scandinavia, Russia, Austria, and some of the smaller States near the Black Sea, have insufficient woodlands to supply the timber that is necessary for their requirements. In 1840, Belgium imported 187,920*l.* worth of timber, but in 1893 the imports were valued at 4,677,880*l.*, together with about 1,200,000*l.* of wood-pulp and other articles manufactured out of wood, such as matches, gun-stocks, masts, furniture, bark, &c. The annual exports of wood from Belgium are now valued at 600,000*l.* only, so that there is an annual deficit of timber production in the country amounting to more than 5,000,000*l.*

The Belgian Government is dealing with this deficit in the most statesmanlike manner, by using all available means for increasing the production of timber, by improving the management of the existing woodlands, and by planting their waste-lands.

The areas of woodlands in Belgium, according to the agricultural statistics of 1895, are as follows:—

Nature of proprietor	Area in acres
State	62,600
Communes	395,455
Public establishments	17,380
Private owners	828,300
Total	1,303,735

The area of forests in Belgium is therefore about one-sixth of the total area of the country.

The small area of the Belgian State forests is chiefly due to the fact that, between 1815 and 1830, when the country was united to Holland, the Government sold all the State forests, and the present area of State forests has been bought back from private owners through the wise policy of the first king, Leopold I.; this has been continued recently by the present Government, which purchases suitable private woodlands whenever they are for sale.

In 1850 there were the following areas of waste-land in Belgium; I have not been able to obtain more recent figures:—

	Acres
State	17,140
Communal	145,267
Private	423,322
Total	585,729

Since 1897 the State has been acquiring waste-lands and re-planting them, 212,960*l.* having been so invested up to date, and land to the extent of 15,317 acres having been acquired and planted.

The State has no power of compelling communes to plant their waste-lands, but important subsidies are granted by the State to encourage them to do so. The Forest Department also organises annual sylvicultural conferences with the object of inducing communes and private owners to utilise their waste lands. This has been so successfully managed, that in the province of Luxemburg, where there were in 1847 126,000 acres of waste-land, by the end of 1887 only 42,000 acres of waste remained in the province, the balance having been converted into 49,000 acres of arable land and pastures and 35,000 acres of woods.

In the space of this short article it is impossible to do more than give a mere sketch of the interesting woodlands recently visited by the Royal English Arboricultural Society in Belgium. It would interest British municipalities, such as those of Liverpool and Leeds, that are engaged in planting the catchment areas of their waterworks, to see the immense tract of woods that cover the catchment area of the Gileppe, a stream rising in the Ardennes and feeding a large reservoir, constructed between 1869 and 1898, to supply water for the population that carries on the extensive woollen industry in Verviers and the other hamlets lower down. The planting with spruce of the Hautes Faynes, or peat district of the Hertogenwald, at altitudes between 1600 and 2160 feet, which is being carried on at the rate of 1000 acres annually, is a vast and highly original work, the rapidity and excellence of which merit careful study.

Plantations of Austrian pine on the very dry and hot Devonian limestone rocks, near Rochefort, supply valuable wood as pit-timber, and afford shelter and increased moisture to the neighbouring farms. The domain of Mirwart, belonging to an Antwerp family named von der Becke, and managed by Dr. Schlich, where millions of spruce and other trees have been planted to replace 32,000*l.* worth of inferior timber that was cut out between 1892–1902, was also visited. Here, forty acres of Scots pine, now thirty years old, has already yielded in thinnings, since 1891, 11*l.* per acre net, while in another eight years, when the whole will be felled as pit-timber, it will yield 64*l.* per acre, or a total return, including thinnings, of 75*l.* per acre.

The domain of Chenoy, belonging to Mr. Boël, contains magnificent beech, oak, and ash standards over coppice. The underwood is sold as pit-timber. Oak trees containing 100 to 140 cubic feet (solid measure) are not uncommon, and some of the ash standards are quite as large. These trees sell standing at 2*s.* and 2*s.* 6*d.* per cubic foot. Abeles (*Populus alba*) up to 80 feet in height are not uncommon, and sell at 9*d.* per cubic foot. It is a curious feature of these woods that whenever the aspect is south or west, the poor Tertiary sandy soil (Bruxillien), from which the fertile superficial loam has been washed, will yield only pines or birch, while immediately the aspect changes to north or east, and the loam remains *in situ* over the sand, splendid broad-leaved woods are produced. In the valleys, Silurian rock crops out from below the sand, all the usual intermediate strata being absent. There we saw a considerable area of Scots pine wood, about forty years old, the trees of which are being pulled up by their roots by a machine, "La

déracineuse Lobo." This operation costs 4*d*. per tree uprooted; but the poles are thus a foot longer than those that are simply felled, and the roots are used for fuel, while the land can be at once planted, without waiting three years from fear of the pine-weevil (*Hylobius abietis*), which otherwise breeds in the stumps, and then destroys the young crop planted to replace the felled trees.

The last forest visited by the society was the Forêt de Soignes, one of the most magnificent beech forests in Europe. The oldest crops consist of columnar beeches 130 years old, 130 to 140 feet high, averaging $4\frac{1}{3}$ feet in girth at chest height, and containing per acre 7000 cubic feet (quarter-girth measure). This forest of 10,210 acres yields a net annual revenue of 18,000*l*. for timber alone; the game, chiefly roebuck, rabbits, and pheasants, is fully worth 4*s*. an acre, but is retained for the King.

The geographical arboretum at Tervueren merits special attention. Here, 75 acres of good undulating loamy land, with a crop of small oak and other saplings, which serve as a shelter-wood, are being planted with exotic trees. The whole area is subdivided into the Old and New Worlds, and each of these into smaller sections, representing countries running from north to south. Thus the "New World" is first subdivided into the Pacific and Atlantic regions, and the former into Alaska, Rocky Mountains, Pacific coast region, and Chile. The Atlantic region into Canada and the Alleghany Mountains. The Old World comprises Northern, Central, and Eastern Europe, Siberia, Caucasus, the Himalayas, Japan, and N. China.

In each of these regions the characteristic trees, broad-leaved and conifers, are planted in their natural mixture. It is also intended to plant among them the shrubs and herbaceous plants that naturally grow with the trees, and this has already been done for Japan. Mr. Bommer, the curator of the Botanic Museum at Brussels, is in charge of this arboretum. He has an extensive forest nursery where he rears the necessary plants. This bold and scientific design is due to the initiative of the King of the Belgians, who has presented the State with the splendid domain of Trevueren, the management of which he still controls.

The Director-General of Forests, Mr. Dubois, has certainly organised the administration of the Belgian forests in a remarkably progressive way, and the system he has adopted in Belgium is probably more suited than those of France and Germany for the future development of forestry in Britain. W. R. FISHER.

THE CAPE GEOLOGICAL SURVEY.[1]

THE presentation of the ninth annual report of the Geological Commission of the Cape of Good Hope will be welcomed by all interested in the prosperity of one of our oldest colonies in Africa. We have been so long accustomed to see similar surveys started and then abandoned before sufficient information had been obtained to yield permanent results that we were afraid that the publication of this report might possibly have been postponed. The past record of surveys of Cape Colony has, indeed, been a dismal one, so hampered have they been in their prosecution, so undervalued have been the results. Fortunately, necessity knows no law, and there are few portions of Africa which do not possess a more or less fully equipped geological survey.

A considerable amount of new and useful knowledge was obtained in Cape Colony during 1904, though the results are not so complete as they doubtless would have been if lack of funds had not prevented the continuation of the survey in important areas, but where the cost of hired transport was found to exceed the limit of the grant voted for the survey.

In the introduction by the director the main results obtained during the past year are recorded, but all too briefly. How little is known of the different rock groups even in these southern and best known regions of Cape Colony is shown by the discovery of a new set of rocks, termed Nieuwervst series, which are found to be newer than the Ibiquas and Malmesbury series, but older than the Table Mountain Sandstone. The succession in southern Cape Colony, the type region for South Africa, is thus being brought into closer approximation with that of northern Cape Colony and the Transvaal, with a result that cannot fail to be beneficial to both. Further, a closer parallelism is found to exist between the geological history of South Africa and the southern continents than zoologists and geologists dared to hope, but on which each alike confidently felt would be the case.

In the detailed account Mr. Rogers describes the geology of the north-western part of Van Rhyns Dorp. Among the Malmesbury beds a characteristic feature consists of the abundance of crystalline limestones intercalated between slates and phyllites. The account of the intrusive granites and the metamorphic rocks with the associated sillimanite-cordierite schists contains much of interest. The Ibiquas series and the unconformably overlying Nieuwervst series deserve close attention, owing to the light they will probably throw on the Transvaal succession.

In the district of Long Kloof Mr. Schwarz finds the geology to be highly complicated by folding. A somewhat fanciful explanation is offered to account for the elevation of the mountains in this area being no greater than in the less folded regions composed of the same rocks.

In the description of the geology of Aliwal North, Herschel, Barkly East, and part of Wodehouse, Mr. du Toit enters into much detail concerning the stratigraphy and composition of the Upper Karroo beds and the volcanic phenomena associated with them. A great addition to our knowledge of the sedimentary and volcanic beds of the Stormberg series will here be found. By means of the special reptilian contents in the upper portion of sandstones, red and purple shales, mudstones and clays, it has been found possible to subdivide the great thickness of the Beaufort series. For this superior group the term Burgersdorp beds is proposed. Besides their abundant reptilian contents, they are further interesting from the occurrence of Lepidodendron in association with Glossopteris and Thinnfeldia.

In the succeeding Stormberg period chief interest is centred in the careful description of the volcanic outbursts, more especially of that of the volcanic necks. Of these, thirteen are recorded from Wodehouse, twenty from Barkly East, and twenty-two from Herschel, those in Aliwal North being left for further investigation. The description includes most reasonable hypotheses for the formation of the different types of rock infilling the necks. The immense flows of lava and numerous dolerite intrusions receive due attention, the intrusion of the dolerites being placed somewhere between the Middle Jurassic and Lower Cretaceous.

Questions of economic importance will be found to have been thoughtfully considered. It is disappointing to find that so far the coal seams met with in Aliwal North and Herschel are thin and of less value than in the south.

The introduction throughout the report of black and white geological maps of the areas surveyed with a sufficient number of place-names enables the reader to follow the various descriptions with ease. The absence of headlines, and the want of a copious table of contents, constitutes a drawback to the general reader, particularly where the report deals with petrological descriptions.

Those persons who consider that the work of a national survey should be primarily devoted to the economic aspect of the inquiry will doubtless be disappointed at the apparent poverty of the commercial results obtained by the Survey since the date of its commencement in 1896. The explanation is obvious. A national survey cannot be formed for a particular section of the community interested in the discovery of gold, coal, or diamond fields. It is, however, expected of such a survey, and that of the Cape fully realises the expectation, that the maps and memoirs it publishes should represent the most trustworthy and technical information it is possible to obtain as to the geological structure of the country it professes to examine, and on which the practical man who follows must and does base his conclusions. W. GIBSON.

[1] Ninth Annual Report of the Geological Commission of the Cape of Good Hope. Pp. 181. 1904. (Cape Town, 1905.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The list of the scholarships awarded at the twelve larger colleges was issued last Saturday. Excluding exhibitions, sizarships, and subsizarships, the amounts of which are uncertain and the number in many cases undetermined, the amount given away in the twelve colleges amounts to 5430*l*. The seven colleges, Pembroke, Caius, King's, Jesus, Christ's, St. John's, and Emmanuel, gave away sixty scholarships of a total value of 3380*l*.; whilst the Trinity group, consisting of Trinity, Clare, Trinity Hall, Peterhouse, and Sidney, gave away 2500*l*. for thirty-seven scholarships.

The total amount in the former group given for classics is 1560*l*., for mathematics 1000*l*., and for natural sciences 620*l*., the number of scholarships being:—in classics twenty-six, in mathematics seventeen, and in science twelve. The proportion of science to the other subjects is better in the group of five colleges, for their science scholarships numbered ten of a value of 560*l*., as opposed to sixteen scholarships in classics the total value of which amounted to 880*l*. We have left out of account the comparatively small sum of 340*l*. which was given for history, Hebrew, and modern languages.

DR. H. A. WILSON, senior lecturer in physics at King's College, London, has been appointed professor of physics at the college in succession to Prof. W. G. Adams, who resigned last July.

REUTER'S correspondent at Tokio reports that the resignation of the Japanese Minister of Education has been accepted, and the differences between the university and the Government have thus apparently been settled. Count Katsura, the Premier, has taken the portfolio of education, while retaining the Premiership. The resignations tendered by the professors have not been accepted.

IN a paper read at the American Mining Congress at El Paso, Texas, on November 14, Mr. V. C. Alderson, president of the Colorado School of Mines, urged mining schools to go beyond mere instruction and to enter the field of research. There was not at present, to his knowledge, a mining school in the United States which had a department of research in good working order. There should, he considered, be such a department at a State mining school to work in conjunction with the State Bureau of Mines.

MR. E. ROBINSON, of Boncath, opened a discussion on the question of the establishment of a school of forestry for Wales at the annual meeting of the agricultural society of the university college at Aberystwyth. He said that, if the seven Welsh counties affiliated to the college would vote on an average 30*l*. each and give an annual subsidy of 100*l*. each for eight years, the proposed school of forestry after that period could easily be made self-supporting. The Government, he urged, must come forward to second the efforts of the county councils by advancing money to landowners at a reasonable rate of interest. Mr. J. Herbert Lewis, M.P., said that the question of afforestation is rapidly becoming one of national concern. A departmental committee has made it clear that a shortage in the world's supply of timber may be looked for in the near future, and that millions of acres of waste land in the United Kingdom are suitable for afforesting. Our large municipalities could do much, following the example of the Liverpool Corporation at Vyrnwy, by afforesting the catchment areas of their waterworks.

SCARCELY a week passes without the announcement of substantial gifts to one or other of the universities of the United States. In addition to those mentioned in NATURE of last week, *Science* announces the following donations:—Mrs. Phoebe Hearst has presented to the California State University her archæological and anthropological collection from all parts of the world. It has cost more than 80,000*l*., and with it she presents to the university 12,000*l*. for the maintenance of a department of anthropology. Hope College, Holland, Mich., recently received 20,000*l*. from Mr. Ralph Vorhees, of Clinton, N.J. A new chemistry hall has been erected for the university of North Carolina by a legislative appropriation of 10,000*l*. Mrs. Clara C. Jacobus has given 5000*l*. to found a fellowship at Princeton University, to be conferred on the graduate student who has reached the highest excellence in his work during the previous year. An anonymous donor has given 2000*l*. to establish a fellowship in chemistry. Mr. Henry B. Loomis has given 2000*l*. to the scientific school of Yale University to establish a fellowship in chemistry.

THE council of the Association of Technical Institutions has issued a report of an inquiry as to the cooperation of employers and technical institutions. A form of inquiry was sent to each of the sixty-five institutions affiliated to the association, to technical institutions and university colleges not thus affiliated, and to some of the large employers of labour whose educational work with their employees was not likely to be connected with the various technical institutions already approached. The answers received to the questions asked on the form of inquiry are analysed under several headings, among which may be mentioned the trades to which the scheme of cooperation applies, the number of students affected by the scheme, the payment of class fees, the provision of books, and leave of absence to attend classes. The report, in its summary of the results of the inquiry, states that if regarded from the point of view of how few of the army of masters appear to interest themselves at all in the technical education of their workers, the record cannot be other than disappointing, especially in view of the different attitude of employers on the Continent and in the United States. On the other hand, if looked at in comparison with the attitude of employers ten years ago, the result is most hopeful. It is interesting in this connection to note that in distributing prizes to the students of the Gateshead higher evening classes, Sir Isambard Owen suggested that it would pay employers to enable their apprentices to work shorter hours by day on condition that they availed themselves of the opportunities for evening instruction. Continuing, he said the great desire of the Plumbers' Company is now to adopt measures for advancing the apprenticeship system, in view of the indisposition of employers, who are keenly competing with each other to obtain plumbing work at a profit, to burden themselves with apprentices, thus ignoring the importance of training the coming generation of plumbers. This pressure of commercial interests over the craftsman spirit constitutes a serious menace to efficiency, not only in the plumbing trade, but in other skilled industries.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 16.—"The Physical and Chemical Properties of Iron Carbonyl." By Sir James **Dewar** and H. O. **Jones.**

The paper contains an account of a study of the properties of iron pentacarbonyl, which has been carried out on the same lines as the previously published investigation on nickel carbonyl. Attention has been directed more particularly to the differences between the iron and nickel carbonyls, such as the difference in formulæ $Fe(CO)_5$ and $Ni(CO)_4$, colour (the iron compound is yellow and the nickel compound is colourless, whereas the salts of the latter metal usually show a much more marked colour than those of the former), and stability, and to the action of light on iron carbonyl.

Pure iron carbonyl is a yellow liquid, which boils at 102°·5 C. and freezes at −20° C. to a yellow solid, which becomes colourless at −180° C. Analysis, vapour density determinations, and molecular weight determinations by the cryoscopic method in benzene show that its formula is $Fe(CO)_5$.

The specific gravity of the compound is 1·4937 at 0° C. and 1·3825 at 60° C.; its critical temperature is 288° C.

The formula $v=1{\cdot}974-0{\cdot}5307\,(\log 288-t)$ expresses the relation between the volume of the liquid v and the temperature t° C.

The relation between the vapour pressure p in millimetres of mercury and the absolute temperature T is expressed by the Rankine formula $\log p=7{\cdot}349-1681/T$.

The critical pressure is calculated to be 29·6 atmospheres, and the critical density 0·49.

The value $\frac{\text{abs. critical temperature}}{\text{critical pressure}}$ is 18·9; this is proportional to the volume of the molecule, and is equal to 5·1 times the corresponding number for carbon monoxide (3·7). The molecular volume of iron carbonyl at its boiling point is 150, so that, taking 7·0 as the volume of the iron atom, 28·6 is the volume of each carbon monoxide group. The molecular volume of carbon monoxide at its boiling point is 35, therefore a greater contraction would occur in the formation of iron carbonyl from liquid carbon monoxide and iron than in the formation of nickel carbonyl under similar conditions.

Vapour density determinations by V. Meyer's method in carbon monoxide, nitrogen, and hydrogen at different temperatures show the effect of increase of temperature and the rapid diffusion of hydrogen in increasing, and of carbon monoxide in diminishing, the dissociation.

The chemical reactions of iron carbonyl are very similar to those of nickel carbonyl, but its stability is greater. Chlorine, bromine, iodine, their compounds with one another and their hydrides react with iron carbonyl giving *ferrous* salts and carbon monoxide; the reaction with bromine takes place more slowly than that between iodine and nickel carbonyl. Neither sulphur nor nitric oxide reacts with iron carbonyl, whereas both react readily with nickel carbonyl. Sulphuric acid, on the other hand, decomposes iron carbonyl more readily than it does nickel carbonyl.

Benzene in presence of aluminium chloride reacts with iron carbonyl, with cold to give benzaldehyde, and at 100° C. to give anthracene, exactly as with nickel carbonyl.

Iron pentacarbonyl alone or in solution in ordinary organic solvents is decomposed by sunlight according to the following equation, $2Fe(CO)_5 = Fe_2(CO)_9 + CO$. The second compound of iron and carbon monoxide is deposited as an orange, crystalline solid from most solvents, but is retained in solution by pyridine. The reaction takes place rapidly under pressures of carbon monoxide up to 150 atmospheres, and yet is very slowly reversed in the dark under small pressures of carbon monoxide. This decomposition takes place slowly at the temperature of liquid air, but if the iron pentacarbonyl or its solutions be heated to any temperature above 60° C., then no solid is deposited and no decomposition occurs. Solutions of iron carbonyl in nickel carbonyl at the ordinary temperature undergo no decomposition and no solid is formed unless the solution contains more than 30 per cent. of the iron carbonyl, when some solid is formed. These solutions are of a much lighter colour than solutions of equal concentration in other solvents, and it is suggested that the two carbonyls may unite to form a compound which is unaffected by light.

The solid iron carbonyl forms lustrous hexagonal plates having a specific gravity of 2·085; its molecular volume is therefore 174.

The solid iron carbonyl when heated alone decomposes at 100° C. into carbon monoxide, liquid iron carbonyl, which is coloured green, and iron; when heated with carbon monoxide under pressure it is completely converted into liquid iron pentacarbonyl.

If the solid iron carbonyl be heated with a solvent such as ether or toluene, a solution of an intense green colour is produced; this green solution on exposure to light deposits the yellow, crystalline, solid carbonyl again. The change from solid to green solution and back again can be repeated indefinitely by the action of heat and light alternately.

Zoological Society, November 28.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—*Exhibitions.*—Photographs of a horse bearing incipient horns: J. T. **Cunningham.** The horns were about ¾-inch in length, the left being slightly larger than the right, and there could be no doubt that they were outgrowths of the frontal bone. The growths were covered with normal skin and hair.—Photographs, taken in the Horniman Museum at Forest Hill, of a sea-anemone (*Anemonia sulcata*) in the process of division: F. **Slade.**—A living albino specimen of the field-vole (*Microtus agrestis*) captured last July in Wales: D. **English.**—A living lizard, *Lacerta muralis*, from Brozzi, province Florence, received from Dr. A. Banchi: G. A. **Boulenger,** F.R.S. The lizard belonged to the typical form of the wall-lizard, but was remarkable for its black coloration above and below. Melanistic forms of the wall-lizard were well known on small islands in the Mediterranean, but, so far as Mr. Boulenger was aware, no black specimen had ever been recorded from the mainland. The scales across the body numbered fifty-eight, and the lamellar scales under the fourth toe twenty-five in the specimen exhibited, these two numbers being sufficient to distinguish the Brozzi lizard from the melanotic insulars previously described.—A living specimen of the violet-cheeked humming-bird (*Petasophora iolota*) brought from Venezuela and presented to the society's menagerie: Captain A. **Pam.** A general account of the habits of these birds, as observed by Captain Pam, in a wild and captive state, and notes on their management and feeding while in confinement.—A named set of the birds collected in Japan by Mr. M. P. Anderson in connection with the Duke of Bedford's exploration in eastern Asia: W. R. **Ogilvie-Grant.** No new species were obtained, but several of the specimens were of special interest as illustrating stages of plumage not represented in the British Museum.—*Papers.*—A transition in the general type of colouring from the wholly black *Colobus guereza* in one direction, through several intermediate forms, towards the black and white *C. caudatus*, and in another direction towards *C. vellerosus*: R. **Lydekker.**—A mounted specimen of the white-maned serow (*Nemorhaedus argyrochaetes*, Heude), of Szechuen, the first example of the species ever received in England, and perhaps in Europe: R. **Lydekker.**—Mammals collected in Japan by Mr. M. P. Anderson for the Duke of Bedford, and presented by the latter to the National Museum: O. **Thomas.** The collection was one of the most valuable for scientific purposes which had ever been received from any one region. More than 600 specimens had been obtained, belonging to 50 species and subspecies, of which several were described as new.—A revision of the fishes of the family Galaxiidæ: C. T. **Regan.** Two genera were recognised, Galaxias and Neochanna, the latter consisting of a single species only. Twenty-eight species of Galaxias were described, including *G. attenuatus*, Jenyns, found on the coasts and in the rivers of Australia, New Zealand and Chili, Patagonia, and the Falkland Islands, and two peculiar to the Cape of Good Hope, five to New Zealand and the neighbouring islands, five to Chili, Patagonia, and the Falkland Islands, and fifteen to Australia and Tasmania. Five species were described as new to science.—The mammalian fauna of China. First paper: J. L. **Bonhote.** The present part dealt with the Murinæ, containing the genera Mus and Micromys, giving descriptions and synonymy, as well as emphasising the distinctive characters by which the various species might be easily distinguished.—Some additions to the knowledge of the anatomy, principally of the vascular system, of Hatteria, Crocodilus, and certain Lacertilia: F. E. **Beddard.**—Descriptions of 111 new species of phytophagous Coleoptera of the family Halticidæ: M. **Jacoby.**

Chemical Society, December 7.—Prof. R. Meldola, F.R.S., president, in the chair.—The constitution of nitrites, part i., two varieties of silver nitrite: P. C. **Rây** and A. C. **Gañguli.** The α variety of silver nitrite is prepared by double decomposition between solutions of silver nitrate and sodium nitrite. The β variety is obtained by dissolving the α variety in boiling water, and from the hot saturated solution the nitrite is allowed to crystallise. The two forms show differences in crystalline structure and mode of decomposition by heat.—The products of heating silver nitrite: E. **Divers.** The author, while accepting Rây and Gañguli's experimental data, dissents from the view that these are two forms of silver nitrite.—A contribution to the chemistry of benzoic sulphinide: F. D. **Chattaway.** When chlorine is passed into a solution of the sodium salt of saccharin, *o*-benzoic N-chlorosulphinide or chloroiminosaccharin is precipitated. An account of the properties of this substance is given.—The action of heat on α-hydroxycarboxylic acids, part ii., α-hydroxymargaric acid, α-hydroxypalmitic acid, α-hydroxy-

pentadecylic acid, and α-hydroxymyristic acid: H. R. **Le Sueur.** The aldehydes obtained by the pyrogenetic decomposition of these acids are white solids, readily soluble in the ordinary organic solvents; they form oximes, semicarbazones, hydroxycyanides, and are oxidised to the corresponding acids.—Studies on optically active carbimides, part ii., the reactions between *l*-menthylcarbimide and alcohols: R. H. **Pickard,** W. O. **Littlebury,** and A. **Neville.** *l*-Menthylcarbimide reacts readily with alcohols, and fourteen of the latter have been shown to yield *l*-menthylcarbamates. These reactions have been studied polarimetrically, and the velocity constants of reaction so obtained compared.—The liberation of tyrosine during tryptic proteolysis. A preliminary communication: A. J. **Brown** and E. T. **Millar.** The authors have applied Millar's method of estimating tyrosine by means of bromination to the study of the tryptic hydrolysis of proteids, and find that tyrosine is one of the first products of such action. The quantitative study of proteolysis in this way may throw some light on the existence or non-existence of a tyrosine nucleus in different albuminoses.—Ethyl piperonylacetate: W. H. **Perkin,** jun., and R. **Robinson.** A description of the preparation of this ester from piperonylic acid.—The action of ultra-violet light on moist and dried mixtures of carbon monoxide and oxygen: S. **Chadwick,** J. E. **Ramsbottom,** and D. L. **Chapman.** It was found that under the action of the rays emitted from a quartz mercury lamp a dry mixture of these gases was largely, but somewhat irregularly, converted into carbon dioxide and ozone. With *moist* gases the rate of conversion was slower and more uniform, and more carbon dioxide was formed and less ozone.—Benzoyl derivatives of salicylamide: A. W. **Titherley.**—The constitution and colour of diazo- and azo-compounds: A. **Hantzsch.** A criticism of Armstrong and Robertson's paper, "The Significance of Optical Properties as Connoting Structure" (*Journ. Chem. Soc.*, 1905, 1272–1297).—Note on the incandescent mantle as a catalyst and its application to gas analysis: J. E. **Mason** and J. **Wilson.** The authors describe a modification of Lewes's method (*Chem. News*, 1905, xci., 61) for showing the incandescence of the mantle in an unburnt mixture of alcohol vapour and air. Although less effective, the mantle may be used as a substitute for platinised asbestos in the ordinary lecture experiments for preparing formaldehyde from methyl alcohol vapour and air, and sulphur trioxide from sulphur dioxide and oxygen, and various applications of mantle fragments to the analysis of mixtures of hydrocarbon gases by combustion are given.—The influence of certain amphoteric electrolytes on amylolytic action: J. S. **Ford** and J. M. **Guthrie.** The results of an investigation of the influence of various amino acids on amylolytic action are given.—The estimation of picric acid additive compounds: F. S. **Sinnatt.** The method of Knecht and Hibbert (*Ber.*, 1903, xxxvi., 1549) for the estimation of picric acid by means of titanous chloride has been found to be applicable to picrates and to picric acid additive compounds.—Silver dioxide and silver peroxynitrate: E. R. **Watson.** The author has analysed the anodic product formed during the electrolysis of solutions of silver nitrate, and finds that its composition was correctly represented by Sûlc's empirical formula $Ag_7O_{11}N$. This compound on boiling with water decomposes, forming silver dioxide, a greyish-black powder which may be heated to 100° without decomposition.—The constitution of *o*-hydroxyazo-compounds. Preparation of benzeneazodimethylcoumarin: J. T. **Hewitt** and H. V. **Mitchell.** Caro's permonosulphuric acid: T. S. **Price.** The author has obtained a mixture containing the potassium salts of sulphuric, permonosulphuric, and perdisulphuric acids. The results obtained by the analysis of this mixture point to the formula H_2SO_5 for Caro's acid.

Royal Astronomical Society, December 8.—Mr. W. H. Maw, president, in the chair.—Account of the results of his recent investigations relating to sun-spot periods: Prof. A. **Schuster.** Besides the recognised 11- or $11\frac{1}{4}$-year period, the author found various subsidiary periods which recur with great regularity, but which sometimes disappear. A period of about $4\frac{3}{4}$ years could be traced back to 1749, and other periods of about $8\frac{1}{2}$ and 13 years were also indicated. Possible explanations of the peculiarities of these periods were suggested.—On the astronomical observations recorded in the Nihongi, the ancient chronicle of Japan: E. B. **Knobel.** The astronomical observations contained in this work comprise eclipses of sun and moon, occultations, conjunctions, comets, meteors, &c., and range from A.D. 620 to A.D. 696. There is great difficulty in fixing the dates of the observations owing to the complicated system of chronology, borrowed from China. The year is a lunar one of twelve months of twenty-nine or thirty days, and an intercalary month every thirty-third month, or seven intercalary months in the lunar cycle of nineteen years. The rules for intercalary months are very complicated, and there is therefore much difficulty in reducing the dates to European chronology. Most of the recorded eclipses agree with Oppolzer's tables when the dates are properly reduced.—On the present state of lunar nomenclature: S. A. **Saunder.** The paper showed the anomalies and irregularities in the present system, resulting in difficulculties of identification in the case of many of the smaller features on the moon which had been selected as points for exact measurement. It was suggested that a committee should be formed to revise the present system of lunar nomenclature.—Photographs of comet *d* 1905 taken with the 30-inch reflector of the Royal Observatory, Greenwich, shown by Prof. F. W. **Dyson.**—Comparison of the results from the Falmouth declination and horizontal force magnetographs on quiet days in years of sun-spot maximum and minimum: Dr. C. **Chree,** F.R.S.—The president announced that the Rev. C. D. P. Davies was giving a demonstration of his system of testing parabolic mirrors.—Other papers were taken as read.

Mathematical Society, December 14.—Prof. A. R. Forsyth, president, in the chair.—Some difficulties in the theory of transfinite numbers and order types: the Hon. B. A. W. **Russell.** The paper deals with the difficulty as to "inconsistent aggregates" and with the question concerning the axiom that every aggregate can be well ordered. It is shown that the difficulties belong rather to logic than to mathematics, and various methods are explained by which steps may be taken towards resolving them.—On well-ordered aggregates: Prof. A. C. **Dixon.**—The Hessian configuration and its connection with the group of 360 plane collineations: Prof. W. **Burnside.** The configuration is that of 9 points in a plane which lie 3 by 3 on 12 straight lines. The first part of the paper is occupied with the establishment of the configuration, and of the nature of the group for which it is invariant, from a geometrical point of view. In the second part it is shown how to construct a configuration of 45 points which lie 5 by 5 on 36 lines, 4 by 4 on 45 lines, and 3 by 3 on 120 lines. From the 45 points 10 Hessian configurations can be formed, and any two of these have one point in common. The configuration is invariant for a group of 360 collineations, which is simply isomorphic with the alternating group on six symbols.—On the representation of certain asymptotic series as convergent continued fractions: Prof. L. J. **Rogers.** The paper is concerned with asymptotic series which represent integrals of the type $\int_0^\infty f(t)e^{-t/x}dt$, where $f(t)$ is a polynomial or is representable by a power series.—The theory of integral equations: H. **Bateman.** The theory is that of the construction of a function ϕ which shall satisfy an equation of one of the forms

$$(1)\quad f(x)=\int_a^b \kappa(x,t)\phi(t)dt,$$

$$(2)\quad f(x)=\phi(x)-\lambda\int_a^b \kappa(x,t)\phi(t)dt,$$

where f and κ denote known functions and λ is a constant. It is shown how to reduce the solution of a linear differential equation to an integral equation of the second type, and that, if is discontinuous in a certain way, a solution of the equation of the first type exists and can be determined.—The imaginary in geometry: J. L. S. **Hatton.**—On a new cubic connected with the triangle: H. L. **Trachtenberg.**

Anthropological Institute, November 21.—*Exhibitions.*—Collection of photographs from Arizona: J. S. **Chase.** These included typical types of the natives, and also illustrated the Mogui snake dance and other ceremonies.—Collection of objects from Siam, including weapons, pottery, and musical instruments: M. **Bidder.**—*Paper.*—Boomerangs: N. W. **Thomas.** The author explained the difference between the return and non-return boomerang, and showed the reasons for the peculiarity of the former kind. Diagrams of the different flights were exhibited, as well as a large collection of Australian boomerangs and African throwing knives.

CAMBRIDGE.

Philosophical Society, November 13.—Prof. Liveing in the chair.—Polarisation phenomena at Guelma in the eclipse 1905 August 30: H. F. **Newall,** F.R.S. The visual observations combined with the photographic records proved that the plane of polarisation of the light diffused by the earth's atmosphere during the eclipse was very nearly horizontal. Photographic records, obtained with a Savart polariscopic camera for the purpose of quantitative measurements of the relative amounts of polarised and unpolarised light in the corona, showed that the polarised portion of the atmospheric light was equal in intensity to the radially polarised portion of the coronal light at a distance of about $1\frac{1}{2}$ diameters from the sun's limb. Thus the phenomena of a radially polarised corona seen through a plane polarised atmosphere are somewhat complicated. The results obtained by photographing the corona through a large Nicol prism, which was set to transmit successively the vertical component and two components which were inclined on each side at 45° to the vertical and consequently perpendicular to one another, not only show the strong radial character of the polarisation of the corona, but also seem to suggest that there is a selective action, and that the prominent streamers of the corona are markedly polarised. A photograph taken with a new form of polarising spectrograph shows a very marked difference in the intensities of the tangential and radial components; but a curious feature in it is that the Fraunhofer lines are not detected in either spectrum, though the conditions are such as must be regarded as very favourable for their detection.—Suggestions for a theory of the Milky Way and the clouds of Magellan: A. R. **Hinks.**—The effect of the lunar deflection of the vertical on latitude observations: B. **Cookson.** The attraction of the moon would cause the plumb-line to be deflected through an angle of $0''.02$ at a maximum, if the earth were a rigid body. It is pointed out that observations made for the purpose of determining the constant of aberration and variation of latitude by Küstner's method are suitably arranged for showing this deflection. A series of observations made at Philadelphia is discussed, but fails to show the direct lunar effect, though it shows an oscillation with a period of half a lunar day, which may be due to the attraction of the ocean tides.

November 27.—Prof. Marshall Ward, president, in the chair.—Some experiments on Canal-strahlen: Prof. **Thomson.** Experiments were described showing that when the stream of positive ions which form the Canal-strahlen fall on a solid, slowly moving kathode rays start from the part of the solid struck by the positive ions; again, metals struck by the Canal-strahlen disintegrate, and the metal is deposited on the walls of the discharge tube; ionisation was shown to accompany the passage of the Canal-strahlen. It is suggested that the reason the α particles of radium lose, as shown by Rutherford, their power of ionisation when their energy falls to a value which, though less than the initial energy possessed by the α particles, is enormously greater than the positive ions in the Canal-strahlen, may be that the α particles lose their charge when their velocity falls below a certain value by combining with a negative corpuscle; the value of this velocity is calculated, and it was shown to be between 10^8 and 10^9 cm.-sec. The spectra produced by Canal-strahlen were discussed, and it was shown that though these rays give rise to the sodium lines when they fall upon sodium salts, they do not do so when they fall upon the pure metal.—Experiments on the retention of an electric charge by gases: W. A. D. **Rudge.**—The effect of hydrogen on the discharge of electricity from hot platinum: O. W. **Richardson.** An account of experiments on the ionisation produced by a platinum tube in air when hydrogen was allowed to diffuse from inside the tube. The negative ionisation was unaffected, whereas the positive was increased by an amount proportional to the quantity of hydrogen diffusing through. The experiments indicate that the increase in the negative leak produced by an atmosphere of hydrogen is due to a change produced by the latter in the surface of the metal, possibly by the formation of an electrical double layer. The experiments on the positive ionisation tend to show that the hydrogen dissolved in the metal is in the form of positive ions.—On colour-inheritance in rats: L. **Doncaster.** Among the varieties of domestic rats there are, in addition to albinos, two types of colour, black and brown (grey). The colour in either case is distributed in one of three very constant patterns; rats may be (*a*) self-coloured, with or without a small white mark on the chest; (*b*) coloured above and white below; (*c*) piebald, with coloured "hood" and back-stripe, elsewhere white. In inheritance, brown is dominant over black, and both over albino. Albinos may bear the black or brown determinant, as in mice, rabbits, &c. When a self-coloured rat is crossed with a piebald, the young have the intermediate pattern (*b*); this is a heterozygous form, and when two of this type are bred together they throw selfs, piebalds, and heterozygous young like themselves. Albinos can also bear pattern-determinants, so that an albino bearing "self" bred with a piebald throws heterozygous young of type (*b*). Self-coloured rats may be entirely coloured or may have a white mark on the chest, but since either form can throw the other, it appears that this is a fluctuating character, and that the pure "self" and white-marked form are not allelomorphic with one another.—A preliminary communication on the life-history of *Pleistophora periplanetae* (Lutz and Splendore): W. S. **Perrin.**—On the osmotic pressure of alcoholic solutions: P. S. **Barlow.**—Two wheels connected by an axle rolling on a rough horizontal plane: G. M. K. **Leggett.**—A series of optically active nitrogen compounds containing the allyl group: Miss M. B. **Thomas** and H. O. **Jones.** The investigation of the relation between the constitution and rotatory power of substituted ammonium ions is being continued. A series of five compounds containing the phenyl, methyl, and allyl groups, together with the ethyl, propyl, isopropyl, isobutyl, and isoamyl groups respectively, has been examined.

PARIS.

Academy of Sciences, December 11.—M. Troost in the chair.—On the distillation of gold, the alloys of gold with copper and tin, and on a new method of preparation of the purple of Cassius: Henri **Moissan.** Gold can be easily distilled in the electric furnace, its boiling point being higher than that of copper, but lower than that of lime. By condensation on a cold tube, the vapour is condensed partly in the form of moss gold, partly as microscopical crystals. The general properties of the condensed gold agree with those of finely divided gold. In the alloys of gold and copper, or gold and tin, the copper and tin distil before the gold. By distilling an alloy of tin and gold, a purple of Cassius is obtained in the dry way.—Nepheline syenites from the Los Islands (French Guinea): A. **Lacroix.** The various types of syenite in these islands are discussed in detail, and complete analyses are given for three typical specimens.—The habits of bees and the colours of flowers: Gaston **Bonnier.** According to the author, the contradictory experiments of various observers on the relations between bees and colour are due to a lack of knowledge of the habits of bees. There is a division of labour among the honey-fetching bees, the duty of those first issuing from the hive being to seek out honey, and not to fetch it. After a certain hour all the bees are engaged in fetching and carrying, and none in hunting for fresh sources of honey, and hence in selective experiments of this sort quite different results can be obtained according to the hour of the day fixed for the experiment. The author's own experiments lead to the conclusion that the bees are not influenced by colour in their search for honey.—Spectroscopic observations made during the eclipse of the sun of August 30, 1905: P.

Salet. The spectrum of the prominences showed lines characteristic of helium, coronium, hydrogen, cerium, titanium, calcium, and iron.—On the new Giacobini comet: M. **Giacobini.** Observations and elements of a comet discovered at Nice on December 6.—On the convergence of the regular continued fractions of the function $F(h,1,h',u)$: H. **Padé.**—On the problem of the motion of a homogeneous fluid ellipsoid all parts of which attract each other according to the law of Newton: W. **Stekloff.**—The theory of a solitary wave which is propagated along a horizontal elastic tube: A. **Boulanger.** The evaluation of the magnifying power of microscopic objectives: L. **Malassez.**—On the co-existence of paramagnetism and diamagnetism in the same crystal: Georges **Meslin.** Experiments are described proving the existence of both para- and diamagnetism in the same crystal of pyrrhotine, and the continuous variation of the magnetic susceptibility with the direction. The action of a magnetic field on the Goldstein rays (Canal-strahlen): Henri **Pellat.** Some curious and somewhat paradoxical experiments on the Goldstein rays are described. In magnetic fields of low intensity the rays behave exactly like positively charged particles. As the intensity approaches 1000 Gauss, the whole tube appears uniformly luminous, and if the magnetic field is still further increased, the luminosity contracts, but the deviation is in the opposite sense to that which is produced in magnetic fields of lower intensity. The author is at present unable to offer any explanation of the phenomenon.—A new arrangement for obtaining a monochromatic image of a source of light: Albert **Nodon.**—On the solution of platinum in sulphuric acid: Marcel **Delépine.** The action of sulphuric acid containing potassium sulphate upon platinum foil has been studied. The action increases with the amount of potassium sulphate present, probably on account of the higher boiling point of the mixture thus obtained. Ammonium sulphate reduces the solvent effect.—On two iodomercurates of lithium: A. **Duboin.**—On a new compound of fluorine and bromine: Paul **Lebeau.** Fluorine unites directly with bromine giving a compound BrF_3. This trifluoride, in which the bromine may be considered as trivalent, is a colourless liquid solidifying on cooling, and melting at 4° C. The chemical activity of this substance is very great, resembling that of fluorine.—Researches on the formation of metallic lustre on the surface of pottery: L. **Franchet.**—On the bromoborates of calcium: L. **Ouvrard.**—On the limiting states of some dissolved chromic salts: Albert **Colson.**—The action of phosphorus pentachloride on β-naphthol: E. **Berger.** Phosphorus pentachloride acting on β-naphthol at temperatures below 130° C. gives a good yield of the ether, $C_{10}H_7—O—C_{10}H_7$; at temperatures above 135° C. β-chlornaphthalene is formed. The yields are not high, but on account of the low prices of the materials it forms a good preparative method.—On some derivatives of anthracene octahydride and on the perhydride of anthracene: Marcel **Godchot.**—The synthesis of dihydrocamphoric acid: G. **Blanc.**—On acetylcyclohexanone: Georges **Leser.**—Anatomical and physiological modifications produced in certain tropical plants by a change of the place of growth: D. **Bois** and I. **Gallaud.** The necessity of taking into account the anatomical changes produced by a change in the environment of a plant is pointed out, and the errors in classification which may arise. The study of the factors producing these changes is also important in the acclimatisation of plants of commercial value. Studies on the influence of light on the development of green plants, carbon dioxide being absent and amides added to the soil: Jules **Lefèvre.**—The granular eruptive rocks collected in Grahamsland by the Antarctic expedition of Dr. Charcot: Ernest **Gourdon.** Exploration in eastern Africa: Maurice **de Rothschild.**—On crystallised hæmatin: MM. **Piettre** and **Vila.** Crystallised oxyhæmoglobin, from the horse, was split up into an albumenoid, globin, and crystallised hæmatin, the pigmented material of the blood, analyses of the latter being given and compared with earlier analyses of amorphous hæmatin of other observers.—The moderating action of catalase on the oxidations produced by extracts from animal tissues: F. **Battelli** and Mlle. L. **Stern.**—On some mineral compounds which behave like the liquefying diastase of malt: J. **Wolff.**—The diastatic hydrolysis of xylane: Gaston **Seillière.** In some molluscs and insect larvæ there exists a diastase capable of hydrolysing xylane to xylose, and for which the name of xylanase is proposed. It is probable that this substance plays an important part in the nutrition of these animals.—The geology of the eastern Pyrenees: Léon **Bertrand.**—On Fontaine-l'Evêque and the caverns of the plain of Canjuers: E. A. **Martel** and M. Le Couppey **de la Forest.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 21.

LINNEAN SOCIETY, at 8.—Report on the Vienna Botanical Congress: Dr. A. B. Rendle.—*Cyrtandraceae malayanae novae*: Dr. Franz Kränzlin.—On Characæ from the Cape, collected by Major A. H. Wolley-Dod: H. and J. Groves.—Note on the Distribution of Shortia, Torr and Gray: B. Daydon Jackson.

CHEMICAL SOCIETY, at 8.30.—The Relation of Position Isomerism to Optical Activity. Part V. The Rotation of the Menthyl Esters of the Isomeric Dibromobenzoic Acids: J. B. Cohen and I. H. Zortman.—Azo-derivatives from α-Naphtho-methylcoumarin: J. T. Hewitt and H. V. Mitchell.—The Supposed Identity of Dihydrolaurolene and of Dihydro-*iso*laurolene with 1:1-Dimethylhexahydrobenzene: A. W. Crossley and N. Renouf.—The Slow Combustion of Carbon Disulphide: N. Smith.

CONTENTS.

PAGE

THURSDAY, DECEMBER 28, 1905.

THE CHEMISTRY OF PLANTS.

Biochemie der Pflanzen. Zweiter Band. By Prof. Dr. Fr. Czapek. Pp. xii + 1026. (Jena: Gustav Fischer, 1905.) Price 25 marks.

THE first volume of this work was reviewed some months back (NATURE, June 22, 1905, vol. lxxii. p. 169), when its general scope and nature were given, and certain remarks were made with respect to its style and structure which are equally applicable in the case of the second volume; hence no recapitulation of these is here necessary.

The material of the present volume is roughly double that of the first, and its magnitude is gauged by the number of the pages given above.

As the first volume dealt with the distribution, metabolism, and metastasis of aliphatic substances, so the second deals with proteinic compounds and the biochemistry of nitrogen, with derivatives of closed rings, and with the inorganic constituents of plants; further, the resorption of oxygen, and phenomena of irritability regarded in their biochemical aspect, also receive detailed attention.

The contents of the volume are divided into thirty-eight chapters, which are followed by addenda and corrections, an index of the subject-matter, another of the names of plants, and finally a list of misprints and errata.

The book opens with a chapter on the general chemistry of proteins. The succeeding chapters are grouped, more or less, into sections under the following headings:—the proteinic metabolism of the Fungi and Schizomycetes, that of seeds and of other organs and groups of plants, the ultimate nitrogenous and anitrogenous products of metabolism, the resorption of oxygen, pigments, ubiquitous cyclic and acyclic compounds, the metabolism of inorganic substances, and lastly the stimulatory action of various bodies.

The opening chapter gives a suitably condensed and, as regards the main outlines, comprehensive account of the chemical and physical properties of proteins and the products of their decomposition. In the succeeding two sections the nature of the proteins occurring in different plants and different organs is discussed, and an account is given of the modes in which these compounds are synthesised and rendered available for metabolic processes when external to the plants. The absorption of soluble nitrogenous compounds is also considered in these sections, which are, in fact, concerned with the general metabolism of nitrogenous substances throughout the vegetal kingdom.

In the next section the ultimate nitrogenous products of metabolism are discussed in detail under the following headings:—oils, purine-bases, nitril-glucosides, bases derived from pyridine and chinoline, and derivatives of indol.

The section devoted to resorption of oxygen deals biochemically with ordinary respiration and the acquisition of chemically-bound oxygen.

Following the sections devoted to pigments, substances of universal occurrence, and the ultimate anitrogenous products of metabolism, is an exhaustive treatment of the metabolism of inorganic constituents in various divisions and organs of plants, and of the modes of their occurrence.

The text concludes with an interesting and well-written account of the stimulatory action of various substances in relation to different vital processes such as fermentation, respiration, photosynthesis, protoplasmic streaming, nuclear division, growth, reproduction, &c.

An idea of the degree of comprehensiveness and detail of the work is afforded by the titles of some of the minor chapters, namely, the proteinic metabolism of pollen-grains, that of fruits, of mosses, of algæ; the inorganic metabolism of subterranean reserve-organs, the inorganic constituents of buds, those of wood, of bark, of algæ, of pollen-grains, of fruits.

The main outline of this volume may be said to have been given in the preceding paragraphs.

What appears most striking here, as in the first part, is the colossal amount of material collected; the labour involved must have been enormous. A result of this is the resemblance of the text of many pages to some highly-condensed abstract, as it is in such places practically a long succession of facts—or reputed facts.

Like the first volume the second is singularly free from misprints and errors of nomenclature. But one scarcely expects to read in a precise botanical work—as on p. 818—of the "stem" and "leaf" of Laminaria, a plant that has neither stem nor leaf. Moreover, in no case has Prof. Czapek attached to the name of a plant that of its author; this omission is certainly a common one in botanical works, but in spite of this most deplorable, since in many cases in which this index fails the nature of the plant is doubtful.

Many useful tables of figures occur throughout the work, and orientation with respect to groups of chemically-allied substances is much facilitated through the interpolation of numerous graphic formulæ in the text.

The literature dealing with the subjects treated seems to have been searched with considerable thoroughness, and that which is most essential referred to in relatively suitable proportion. Possibly those who have made the various branches touched upon their special study might detect important omissions, but so far as lay in the power of one man Prof. Czapek seems to have been very successful in citing all that is most important. The reviewer misses reference to Schjerning's important paper on proteohydrolysis that appeared about three years back in the publication of the Carlsberg laboratories, and he sees no mention in this volume of the work by F. F. Blackman on gaseous exchanges, or of that by Cornevin on the degree of immunity of plants to vegetal poisons of autochthonous and alien origin.

Prof. Czapek is not of the opinion that the acceleration of oxidative processes by various metallic salts in association with colloids is likely to result in modification of existing notions of oxydases. The matter

is one, however, that requires extended quantitative and qualitative treatment. The supposition that an action is *entirely* due to a colloid, because the action ceases on separation of the colloid from the system, is an error commonly made by physiologists, due to the omission of taking into account phenomena of adsorption, and the complete alteration of conditions produced by the change.

There can be no doubt as to the value of this work in its completed form; it traverses practically the whole of physiology in its chemical aspect, so far as it is now possible to do so, and illustrates in an excellent manner the results that have been produced through application of chemical methods to physiological problems; it is the first extended treatise of the biochemistry of plants, and as such fills a void that was distinctly appreciable, and moreover fills it in a manner that places all vegetal physiologists under great obligation to its author.

F. ESCOMBE.

EXPERIMENTS WITH EXPLOSIVES.

New Methods of Testing Explosives. By C. E. Bichel. Translated and edited by Axel Larsen. Pp. 62. (London: Chas. Griffin and Co., Ltd.) Price 6*s.* net.

IN collecting together and translating the papers on the researches carried out in the laboratory of the Carbonite Explosives Company, Hamburg, the translator has given to English readers a valuable and interesting little volume. The title is perhaps a trifle misleading, but the whole-scope of the work may be seen from the following quotation:—"(1) Why does a smaller quantity of one explosive than another cause ignition of fire-damp? (2) What are the incidental phenomena and the influences tending to promote such result? (3) In what manner do they co-operate in producing it?"

Appreciating the fact that it is desirable to work with quantities as nearly as possible approaching those employed in actual practice, special apparatus has been constructed, so that for the particular explosives dealt with we now have details obtained from experiment on a much larger scale than any hitherto adopted. In some cases charges of gunpowder as great as 1500 grams were exploded, and for the higher explosives often 300 grams. Even for the calorimetric determinations the bomb had a capacity of 30 litres, which was capable of taking a charge of 100 grams. There must always, however, be some risk with heavy charges of recording undue pressures, a point to which Noble has directed attention.

The actual pressures, gas volumes and composition of the products were determined from charges fired in Bichel's apparatus, the pressure being recorded by a piston indicator working on a drum. The record is really in excess of the true pressure, but it is stated that the indicated pressure is rarely more than two or three per cent. from the actual. The apparatus permits of variations of surface area for a definite charge, and so the cooling effect of the chamber may be eliminated. It appears that with this allowance the pressure at a given density of loading is proportional to that with higher densities. This, however, may not be strictly true with very high densities.

The actual temperature at the moment of explosion was calculated from the heat developed, the composition of the products and their specific heat, in the usual manner, but all such calculations are uncertain owing to doubt as to the specific heats of gases at these high temperatures, and the impossibility of taking into account dissociation. The possibility of fitting a thermo-junction into the Bichel apparatus might be worthy of consideration, for although the results cannot approach actual values, yet the relative temperatures recorded would probably serve as a useful check on those calculated. Macnab has already employed the thermo-junction for this purpose.

In connection with the safety of explosives for mining, undoubtedly the length of the flame, its duration and temperature are of the greatest importance. The two former were recorded photographically, a quartz lens being used. Some excellent plates of the flames are reproduced. A factor deduced from the ratio of the flame duration to the detonation time, termed the "after-flame ratio," is shown to have the greatest influence on the ignition of fire-damp, and a most instructive diagram shows the temperature developed, the length of flame, and the "after-flame ratio" for the explosives examined.

In considering the efficiency of an explosive the author makes a distinction between the dynamic action, due to the projectile-like action of the products on the surrounding surfaces, and the static energy, deduced in the usual manner from the volume occupied by the products at the calculated temperature of explosion. It certainly seems that a more rational classification is thus possible than when the two are considered together, and the results are claimed to be fairly in accordance with those obtained in actual practice.

The general bearing of the work on the question of safety is clearly dealt with, and four very complete tables give a mass of information relating to the explosives examined.

Sufficient has been said of the contents of the book to convince those interested in the subject of its great value. It deals almost exclusively with mining explosives, but it would certainly be of very great interest if the investigations could be extended to military explosives, for the author has such valuable apparatus at his disposal that experiments on this large scale could not fail to give much valuable information.

J. S. S. B.

CAUSALITY AND THE HUMAN WILL.

The New Science of Causation. By H. Croft Hiller. Pp. xiii+386. (London: The Walter Scott Publishing Company, Ltd., 1905.) Price 10*s.* net.

IF intrepidity were the prime essential of a philosopher, this work would be epoch-making, and its author would be a thinker of the first rank. He claims to have formulated a case—to his mind, abso-

lutely impregnable—against the intellectual foundations of empirical science. So impregnable, in fact, to the author's mind that he can afford to detail in the preface, with inimitable *naïveté*, his many discouragements in the preparation of the work the fact, for instance, that of eight Fellows of the Royal Society with whom he has communicated all have declined to read and criticise advance proof-sheets. Sir Oliver Lodge has even gently indicated that Mr. Hiller's previous works have not impressed him; the letter is printed in full as a kind of *imprimatur*.

Briefly stated, Mr. Hiller's main position is that causality resides solely in the human will, and not at all in matter, atoms, ions, ether, electricity, or any of the other entities with which modern science deals. What reality ordinary objects possess is not quite clear, but apparently the action which we ordinarily suppose them to effect really belongs to the human being using them. Thus "a knife is a fetish facilitating cutting," *i.e.* cutting could quite well be done by the unequipped human will, but human nature being weak finds it useful for ordinary purposes to rely on the God-determined illusion of knives and scissors. Food becomes unnecessary, or can readily be replaced by poisons. In fact, there is no poison or disease at all but thinking, or rather willing, makes it so, *i.e.* if the individual will, acting on its own initiative, has not endowed an object with such and such attributes, then the consensus of other human wills, acting through hypnotic suggestion, so endows it. In this way, we presume, Mr. Hiller would account for the occasional death of infants by accidental poisoning. Doctors not only cure diseases, but also create and propagate them.

Considerations of space forbid a statement of Mr. Hiller's doctrine of perception, with its singularly elegant terminology—top storey of mind, mnemonic storey, and the like. But a word of criticism must be added, even if it is foolhardy to rush in where eight Fellows of the Royal Society have declined to tread. So far as we can understand our author, he seems in too great a hurry to explain abnormal experiences. He revels in things that make our flesh creep, people whose staple diet is strychnine, "Katie King" apparitions, ghosts that have pulses and heart-beats. Now of course we should all like to build up absolutely exhaustive systems, but at present well-sifted evidence of the extraordinary is so difficult to procure, and the abnormal is so often exploited by charlatanism for private ends, that science, which is long and patient, will rather wait a little and concentrate itself upon the normal. Again, there is obviously a difference in the glory of fetishes; there is one fetish which facilitates cutting, and another which facilitates Marconigrams. Will Mr. Hiller seriously maintain that a consensus of even all existing human wills could interchange these at its pleasure? Why had we to wait until the twentieth century for radio-activity? Could a sufficiently strong will in the nineteenth have produced the same effects by means of shoe-blacking?

We gather from the preface that this attempt to prove the rest of the world insane is merely a provisional instalment of a greater work, to be entitled "Sic Transit Scientia"! So important an effort to overthrow the walls of the empirical Jericho must be carefully timed; we can only suggest as the most fitting date of publication the eve of the Greek Kalends.

IONS AND ORGANISMS.

Studies in General Physiology. By Jacques Loeb. 2 vols. Pp. xxix+782. (London: T. Fisher Unwin, 1905.) Price 31*s*. 6*d*. net.

THE two volumes of papers collected under this title form one of the most interesting and suggestive works that have been published on the subject. The bold idea, that by means of alterations in the composition of the solutions that bathe the tissues it is possible profoundly to affect not only metabolism and growth, but also such processes as fertilisation, has led to a series of experiments here recorded that are well worthy of careful study.

The material with which Prof. Loeb and his pupils have worked has been in the main organisms of such a size that the whole animal could be acted on by changes in the salts dissolved in the water in which the animal lived. Most of the experiments were made with either the embryos or eggs of marine animals belonging to the groups of Annelidæ, Echinoderms and their allies; some were on fish embryos, some on hydroids, and the earlier experiments, which seem to have furnished the author with the leading idea for these researches, frog's muscle. This idea, shortly summarised, is that the changes in the composition of the solutions are effective on account of the properties of the various ions added or subtracted, and that by varying these one can control the various biological processes. The control is supposed to be direct, and ions are even termed "toxic" or "antitoxic" according to their suggested action on any process—for example, Sodium ions are "toxic," because they prevent the development of fundulus ova, Calcium ions are "antitoxic" because they neutralise this action.

The experiments which have perhaps attracted most attention are those on artificial fertilisation. Addition of HCl to the water in which the eggs of starfish (Asterias) were suspended caused them to develop parthenogenetically; similarly Ca was efficacious for the eggs of Amphitrite, KCl for Chaetopterus, and either KCl, NaCl, or even evaporation of sea water for the eggs of Arbacia, an Echinoderm. As to the accuracy of the observed phenomena, most of Prof. Loeb's readers will accept the evidence here adduced; whether the results bear the importance attached to them is a more open question. The author himself points out that these eggs are naturally on the brink of parthenogenetic development; in fact, if left to themselves they usually begin to segment spontaneously, and the effect of the addition of the various ions is only to hasten a naturally occurring process. It perhaps asks too much, but one regrets that the experimental difficulties so far seem to have prevented any of the parthenogenetic animals from attaining adult life.

For the rest, one notices that Prof. Loeb derives his inspiration from internal sources, and that quotations from other authors and from the *Archiv f. allgemeinen Physiologie* occupy but a small place. What, however, is more natural, if an author has sufficient new and interesting material to draw upon, than to confine himself to his own observations? Enough has been said to convey our impression that the two volumes now under review well repay careful consideration, and that the facts recorded therein mark an important advance in our knowledge of general physiology.

OUR BOOK SHELF.

Civil Engineering: A Text-book for a Short Course. By Lieut.-Col. G. J. Fiebeger, U.S. Army. Pp. xiii+573. (New York: Wiley and Sons; London: Chapman and Hall, Ltd.) Price 21*s.* net.

THIS text-book on civil engineering is especially intended for the use of cadets of the U.S. Military Academy, whose duties later are often those of a civil engineer. A short course on this subject is therefore provided, and this work is evidently based on the author's lectures at West Point. It is natural to expect that in these circumstances the treatment of the theory of structures will be that of the engineer rather than of the pure mathematician, and that it will be of the simplest possible character. It is therefore disappointing to find that this section is treated in an almost purely academic way involving much chasing of x, with little or no appeal to physical ideas. This is well illustrated by chapters iv. and v., mainly on the deflections of beams under various conditions of loading and fixing, a section of forty-nine pages, involving one hundred and ninety-three numbered equations, with little or no indication of their physical meaning. A semi-graphical treatment would have been far preferable for military cadets studying this subject with a view to practical applications, and this remark applies to other parts of the book; thus we should imagine that a student, after reading chapter iii., on the flexure and bending of beams, would have considerable difficulty in calculating the moment of resistance of a section such as a bridge rail, a perfectly easy problem by a semi-graphical method and one likely to require solution by an officer who "in an isolated station finds himself called upon to act as an engineer and constructor of buildings, roads, and bridges," with possibly a miscellaneous collection of materials.

In the purely descriptive part of the book the author is much happier, and a great deal of valuable information is contained in this section. Throughout the book the author is somewhat free with his terms; thus his use of the word molecule leads him to the statement that "the unit shearing stresses on the vertical and horizontal faces of the elementary molecule are equal," while other terms, such as "curve of mean fiber" and "spontaneous axis," might be amended with advantage. E. G. C.

Thunder and Lightning. By Camille Flammarion. Translated by Walter Mostyn. Pp. 281. (London: Chatto and Windus, 1905.) Price 6*s.* net.

THIS book contains no translator's preface, so one is apt to believe that it is a translation of M. Flammarion's "Les Phénomènes de la Foudre." A comparison of the two volumes shows that the titles of the chapters in each are identical, with the exception of two chapters of the French work which are merged into one in the translation. A closer examination leads one to conclude that the English edition is a very abridged form of the French, and the illustrations, which number fifty-four in the latter volume, only total nine in the translation. It is clear, therefore, that the two volumes are very different from each other, although one is supposed to be a "translation" of the other, since nothing is said to the contrary.

Apart from the above mentioned differences the English translation is well done, and will be found very interesting reading. The greater portion of the book is devoted to the effects of lightning flashes, and a large number of examples are described. Thus we have the effects on mankind, animals, trees, plants, metals, objects, and houses. Many instances are narrated of the vagaries of fireballs, and two chapters are devoted to atmospheric electricity and storm-clouds, and the flash and the sound.

Photography for the Press. By the editor of *The Photogram.* Second edition. Revised and very largely rewritten. (London: Dawbarn and Ward, Ltd., 1905.) Price 1*s.* net. Cloth, 2*s.* net.

THIS very complete and practical book contains hints to the photographer who wishes to make use of his pictures for press purposes. The editors acknowledge that this is a new departure in photographic literature, but the fact that the present edition is the second indicates that a want has been supplied. So large is the number of illustrated journals, books, &c., at the present time, and they are still on the increase and likely to become much more numerous, that time and possibly disappointments will be saved to the photographer if he becomes acquainted with many of the hints included in the present issue. In addition to some general remarks about the relation of the editor and publisher to the photographer, practical field and workshop methods are also discussed. Interesting and valuable information on the copyright union, copyright law, permits to photograph, &c., are next taken up, and lastly there are lists of agents for press photograms, publishers of picture post-cards, and the principal illustrated periodicals with all up-to-date information, such as class of print preferred, size of page, date and time to which originals are usually received for current issue, &c.

From the above it will be gathered that the book is intended to serve a very practical purpose, and the editors have produced a book that will be serviceable to many photographers.

How to Know the Starry Heavens. By Edward Irving. Pp. xvi+313. (London: T. Fisher Unwin, 1905.) Price 8*s.* 6*d.* net.

THIS volume is, avowedly, not so much a text-book for astronomical students as "an invitation to read text-books on the subject," but while it contains a large amount of real information, we fear that the matrix is so bulky that the reader to whom the book is intended to appeal will find great difficulty in discovering and assimilating the real facts. After discussing the apparent motions of the heavenly bodies and the rival theories concerning them, the reader is conveyed towards α Centauri in "The Chariot of Imagination" in order to gain some idea of the cosmological insignificance of the earth and to view more closely the sun and his system. Then the author attempts to instil a concrete idea of the dimensions of the visible universe. To this end he gives about twenty different illustrations, each one under a prominent subtitle such as "A Pile of Blood Discs" or "A Spider's Web," the whole occupying about fourteen pages. Succeeding chapters deal with other astronomical subjects in a popular manner and with more or less convincing illustrations.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Magnetic Storms and Auroræ.

The observations of your correspondents Mr. Rowland A. Earp and Mr. R. Langton Cole, published in Nature of November 23 (pp. 79–80), remind me that an aurora was also visible here (Cape Breton Island, Nova Scotia) on November 15 about 6 p.m., Halifax time.

Although only faintly visible on account of the twilight and the condition of the sky, the aurora was evidently of considerable intensity, throwing up streamers to the zenith.

I looked out again at 7 p.m., but could detect no signs of auroral activity then. Occasional watch was kept upon the northern sky during the rest of the night in hopes of a recurrence, but nothing further was seen.

Alexander Graham Bell.

Beinn Bhreagh, near Baddeck, Nova Scotia, December 9.

With reference to a letter from Dr. Chree in Nature of November 30 (p. 101) upon the magnetic storm of November 15, it may perhaps be of interest to mention that, according to a notice in the newspaper *Finmarken*, the aurora of that day in Vardö (lat. 70° 22′) was by far the most splendid seen there for many years. It is described as bright red all over, and, when most vivid, forming a belt over the whole sky from south-west to north-east. At last, about 11 p.m., the light gathered in the southern sky, making the impression of a huge fire some forty kilometres away.

Here in Christiania the sky was overcast, except a low horizontal stripe in the north-west, where the vivid greenish light was moving to and fro about 7 p.m.

H. Geelmuyden.

University Observatory, Christiania, December 16.

The Origin of Variations in Animals and Plants.

Having found much ambiguity in discussions of this subject, I have tried to formulate briefly the probable facts, as they appear to me.

(1) In the beginning, the germ-plasm was not separated from the somato-plasm, and hence it is assumed that "acquired characters" were inherited, and, we must suppose, still are by the protozoa. It seems probable, however, that the obvious effects of the environment were not permanent, but were recovered from in a few generations of cells or individuals, much as they are frequently recovered from in the metazoa during the life of a single individual. When they were too severe, they probably resulted in the death of the affected individuals or strains. In other words, there has been no regular "inheritance of acquired characters" among the protozoa any more than among the metazoa.

On the other hand, it seems reasonable to suppose that there were other more subtle effects, which in various slight ways *changed the molecular arrangements or composition of the plasm*, and effects so produced would be permanent until further changes of a similar nature took place.

The extraordinary permanence of type of protozoan and protophytan species, both in time and space, compels us to discard the idea that they are easily modified by external or any other conditions; while their marvellous diversity shows that they are *capable* of extraordinary modification. What causes the molecular changes (presumably nobody denies that they take place) is not apparent to us, partly because the phenomena must be very difficult (or impossible?) to demonstrate, and partly, perhaps, because they have been overlooked, all attention having been given to the obvious but less significant changes. Recent physical science has made us familiar with all sorts of subtle influences, and we do not know how any of them might affect the complex molecule of a living creature. Substances which hitherto behaved in a perfectly well known manner have given us surprises when we placed them in the presence of something new. So it may well be with the living molecule, and what we call "great changes in environment" may be nothing at all to it, compared with subtle influences which entirely escape our observation.

(2) In the first place, the molecular changes may have been good, bad, or indifferent (as tested by the prosperity of the creatures); but very soon selection would get in its work, and *those types of plasm which responded in certain ways to the more usual influences would be perpetuated*. Hence it would presently be found that variations were no longer indefinite, but were in certain prevalent directions—as they assuredly are.

(3) The fact that protoplasm shows such very definite tendencies low down in the scale of life (so that the hydrozoa, for example, seem wonderfully prophetic of subsequent evolution) might be used as an argument that life did not originate upon this earth, but came here with a long history already behind it.

(4) In the metazoa the matter is immensely complicated, because we have in each individual not one, but a large number of more or less independent variables. Nevertheless, I cannot doubt that the germinal elements are, as I have supposed in the protozoa, caused to vary (and nobody disputes the variation) by external influences; yet, from the selection and evolution of ages, their reactions have become so definite that we cannot see in them anything but "the nature of the beast."

(5) Since those germs would be selected (through their somata) which reacted in such a way as to produce the most favourable variations, it becomes easy to see why certain kinds of variation may be carried *beyond* the point of maximum utility. They are like habits, which may be formed in response to certain needs, but which afterwards become tyrannical, because the individual has acquired the property of responding to particular stimuli, and cannot stop when the stimuli become more numerous, or the effects accumulate unpleasantly.

(6) The fact that certain genera (*e.g.* Rubus, Aster, Agriolimax) are extremely prolific in species in some regions, and very little so in others, seems to show that some external influences have been at work in the former case and not in the latter. We may also direct attention to the effects of changed conditions in producing variability (*e.g.* in *Helix nemoralis*), and to the evolution of similar types in different regions.

(7) It may well be that the *appearance* of characters in the soma does not always or often follow in the generation after the germ is affected (*cf.* Nature, February 16, p. 366).

T. D. A. Cockerell.

Boulder, Colorado, U.S.A., December 1.

An Acoustical Method for the Demonstration of the Magnetism of Liquids.

One end of a glass tube, about 5 mm. internal diameter and 1 mm. thick, is heated in a blowpipe flame until the molten end contracts to a round nozzle, leaving a small aperture of less than half a millimetre at the middle. The other end of this tube is connected by a caoutchouc tubing to an air-bag of considerable capacity, which is pressed by a constant weight. The nozzle is wet with a drop of liquid. By opening the cock of the air-bag, the air escapes through the nozzle and produces a clear musical sound, the pitch of which depends upon the dimensions of the nozzle as well as the quantity and the nature of the liquid; it varies also with the pressure of the air inside and the inclination of the tube to the vertical.

If the nozzle, wet with a magnetic liquid, be brought close to the conical pole-piece of a strong Faraday's electromagnet and the field excited, the pitch of the sound changes more or less according as the magnetic susceptibility of the liquid and the gradient of the field is greater or less. With concentrated solution of ferric chloride or manganese chloride, a change amounting to an interval of a third is easily obtained.

The details have been published in the *Proceedings of the Tokio Physico-mathematical Society*, vol. ii., No. 26.

T. Terada.

Science College, Imperial University, Tokio, November 5.

THE PANAMA CANAL.

IN the issue of August 24 a review was given of General Abbot's book on "Problems of the Panama Canal," published this year; and in this book the construction of a canal with locks across the Isthmus of Panama, in preference to a sea-level canal, was strongly insisted upon. The October number, however, of the *National Geographic Magazine*, published in Washington, contains an article on "The Panama Canal," by Rear-Admiral Colby M. Chester, U.S.N., in which the advantages of a sea-level canal are quite as urgently advocated. Accordingly, the only points which have hitherto been definitely settled by the United States Government assuming the responsibility for the construction of the canal, are the final selection of the Panama route for the inter-oceanic canal and the consequent abandonment of the rival Nicaragua scheme, and the certainty of adequate funds being available for the completion of the Panama Canal, the want of capital having proved the most serious obstacle to the progress of the works when under the control of a private French company.

Photograph by W. P. Tisdel.

FIG. 1.—The Culebra Cut, Panama Canal looking North.

There are undoubtedly several difficulties connected with this enterprise which have still to be overcome, such as scarcity of labour and unsanitary conditions in a proverbially unhealthy tropical climate; the vast amount of excavation that has to be accomplished in cutting through the high central ridge constituting the divide between the Atlantic and Pacific watersheds (Fig. 1), composed in the higher portions of treacherous strata exposed to an exceptionally heavy rainfall; and the control of the great torrential floods of the river Chagres cutting in several places across the line adopted for the canal, which follows the valley of the river along the Atlantic slope. These impediments, however, in course of time, by the help of ample funds, the progress of sanitary science, the great improvements effected in excavating and dredging plant (Fig. 2), and the increased experience gained in the construction of reservoir dams, should not prove insurmountable. In reality, the question which at the present time demands a definite and early decision is whether the canal is to be constructed with a summit-level a considerable height above sea-level, to be reached by means of locks on each slope, or is to be excavated down to a sufficient depth to form a sea-level canal with only a regulating lock, $4\frac{1}{2}$ miles from the Pacific coast to Panama, to prevent the tidal rise in the Pacific Ocean of $21\frac{1}{3}$ feet at springs creating injurious currents into and out of the canal.

When the Panama Canal scheme was started at Paris in 1879, M. de Lesseps insisted that it should be constructed at sea-level, like the Suez Canal; and the works were commenced in 1881 on that basis, relying upon the eventual success of the earlier work, without adequate preliminary investigations, and without due consideration of the differences in the conditions of the two sites. In 1887 the unexpectedly large cost and slow progress of the works led the canal company to diminish considerably the amount of excavation by the introduction of locks, thereby effecting a large reduction in the ultimate expenditure, and in the time required for the completion of the canal, as can be readily appreciated by a reference to the longitudinal section of the canal with locks (Fig. 3).

Photograph by W. P. Tisdel.

FIG. 2.—A Steam Shovel at work in the Culebra Cut, Panama Canal.

This is the principle upon which work on the canal since that time has been conducted, with modifications from time to time in the proposed summit-level; it was followed, after the failure of the old company in 1888, by the new company constituted in 1894, so far as their limited funds permitted; it was approved by the various French Commissions which reported on the canal; and it was adopted by the International Isthmian Canal Commission of 1899–1901, which submitted to Congress the design shown by the accompanying longitudinal section and plan. This design consists of a summit-level $21\frac{1}{2}$ miles long, with its water-level 82 to 90 feet above mean sea-level, reached from the sea-level portion of the canal on the Atlantic side, 16 4-5 miles long, by two adjoining locks at Bohio, and from the sea-level section on the Pacific side, about $8\frac{1}{2}$ miles long, by a lock at Miraflores arresting the tide and raising the water-level of the construction of the Panama Canal," in which a sea-level canal is recommended, thereby abandoning the proposals of all the engineers who had previously studied the question since 1888, and reverting to the original scheme of M. de Lesseps. This project consists of a canal with a bottom-width of 150 feet, a minimum depth of water of 35 feet, and twin tidal locks at Miraflores having an available length of 1000 feet and a width of 100 feet; and it is estimated that this canal could be completed in ten or twelve years at a cost of 230,500,000 dollars, the Chagres River being controlled by a dam at Gamboa, forming a lake from which the surplus waters would be discharged by a tunnel through the dividing ridge into another river-basin. The committee further urges that if a canal with locks should nevertheless be preferred, its summit-level should in no circumstances have its

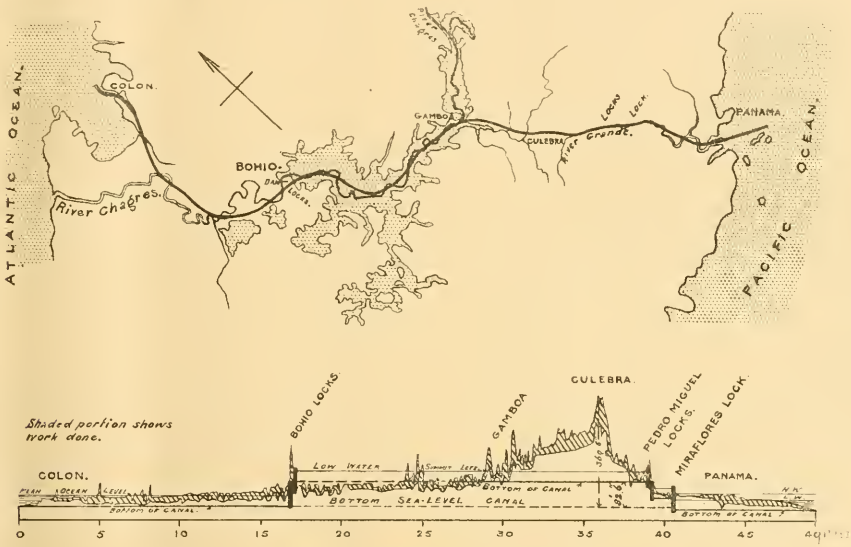


Fig. 3.—Panama Canal. Scheme with Locks. Commission of 1899–1901. Plan, Scale 1/600,000. Longitudinal Section, Horizontal Scale 1/600,000, Vertical Scale 1/6,000.

canal 30 feet above mean sea-level in a reach only $1\frac{1}{3}$ miles long, and two adjoining locks at the end of this reach connecting it with the summit-level (Fig. 3). For thirteen miles of the summit-level on the Atlantic side of the deep Culebra cutting, the canal would pass through a lake formed in the Chagres valley by a dam near Bohio, as shown on the plan, which would materially accelerate navigation along this part. In an article on "Progress of the Panama Canal," following the one by Admiral Chester, to which the plan and section here reproduced are appended, it is stated that this design with locks is the only one "on which the Canal Commission has as yet any authority to spend money."

The canal problem entered upon a new phase this year by the presentation last February of a report to the United States Isthmian Canal Commission by its Engineering Committee, which Admiral Chester terms "the first definite engineering plans for the water-level more than 60 feet above mean sea-level, and estimates that such a canal would cost 178,013,406 dollars, and a canal with only a 30-feet summit-level 194,213,406 dollars. The committee considered that a sea-level canal, which is free from the restriction imposed by locks on the volume of traffic and size of ships passing through them, and could easily be enlarged and deepened to accommodate an increased traffic and larger vessels, would be well worth the additional cost, and that in view of the great progress achieved in the rate of excavation, the period required for its construction would be moderate; and the opinion was expressed that though a canal with locks could be made which might subsequently be transformed into a sea-level canal, such a modification could only be effected at great inconvenience to navigation, and at an excessive cost. A scheme proposed by Mr. Bunau-Varilla with this latter object in view is described in the article on "Progress of

the Panama Canal," in which four locks on each slope would lead to a summit-level 130 feet above sea-level; and so by greatly reducing the excavation required in the Culebra cutting, the designer considers that the canal could be completed in four and a half years; and it is proposed that a very wide earthen dam should be formed at Bohio with materials dredged in excavating the canal, and conveyed through pipes to the site, thereby creating Lake Bohio, as shown on the plan. Another lake would be formed by a dam at Gamboa, outside the line of the canal; and this canal with locks is to be transformed into a sea-level canal, when required, entirely by dredging without impeding navigation, the dredgers being worked electrically by means of the water-power from the lake, the basin of which is to serve as a depositing ground for the dredged materials.

Admiral Chester, as an old naval officer, is naturally in favour of a sea-level canal, and supports his view by numerous extracts from the report of the Engineering Committee; whereas General Abbot, with his wide hydraulic experience, and the International Isthmian Canal Commission of 1899–1901 have advocated the construction of a canal with locks. In face of this conflict of opinion, it is natural that the United States Government referred the technical question last summer to an International Engineering Advisory Board, which recently visited the site; but, according to some newspaper correspondents, the members of this commission returned to Washington with discouraging and discordant views, so that their approaching report to the President will be awaited with much interest.

Undoubtedly, the conditions affecting the choice between a canal with locks and a sea-level canal have been modified by the United States Government having undertaken the construction of the canal, for the capital cost, which is a most important question for a private company, is of much less consequence to a Government, provided very material advantages, either as to facilities of navigation or a diminution in the expenses of maintenance, can be secured by a larger initial outlay; and, within certain limits, a prolongation of the period of construction is also of less vital importance. Too much stress, however, appears to have been laid in the report of the Engineering Committee of this year on the restriction offered by locks to navigation and increase in the size of ships, and too little account taken of the cost of enlarging a canal through an exceptionally deep cutting; and also probably much too sanguine a view is entertained of the period required for the large additional quantity of excavation necessitated by a sea-level canal, especially considering the uncertainties as to the supply of labour.

The only restrictions to navigation caused by a canal with locks are the time occupied in passing through them, and the possibility of vessels being built larger than they could accommodate; but the loss of time can be considerably reduced by suitable arrangements for filling and emptying the locks, their capacity for traffic can be readily increased by duplicating them when required, and their dimensions would naturally be made at the outset, like the tidal locks at Miraflores, adequate for any probable increase in the size of the vessels. Moreover, in the design shown on the plan, a great portion, if not the whole, of the time expended in locking would be recouped by the increased speed attained by vessels in traversing the thirteen miles of lake navigation. The advantage of facility of enlargement claimed for a sea-level canal really more rightly belongs to a canal with locks, provided the locks are constructed with due foresight of future requirements; for whereas the portions of the canal from the Atlantic to Bohio, and from the Pacific to Miraflores, with a total length of $25\frac{1}{4}$ miles, are the same in both schemes, owing to the excavation already accomplished, as shown by shading on the longitudinal section, about 11 miles of the lake portion in the canal with locks are considerably lower than required for giving 35 feet draught of water; whilst the remaining $10\frac{1}{2}$ miles of the summit-level of the canal with locks could be enlarged and deepened by 82 feet less depth of excavation throughout than would be necessary for the sea-level canal (Fig. 3).

The only serious objection that has been raised against the design shown in the illustrations is that the proposed dam near Bohio would have to be carried down 42 feet lower to reach a foundation of rock than was anticipated; but it seems almost incredible that the commissions appointed during the period that the New Panama Company had control of the works, the special mission of which it was to determine the feasibility and best means of completing the canal, should have neglected such an important investigation as the foundations for the Bohio dam. The statements that the Engineering Committee, in its report of this year, had presented the first definite plan for the construction of the canal, and that the American engineers had discovered a better site for a dam at Gamboa, which formed part of the original scheme, seem to indicate a bias against previous schemes, and a desire to appear to strike out a novel line. So far as information is at present available, and assuming that the Bohio dam can be executed as designed, it appears that a canal with locks would cost much less, be much sooner completed, and would be much more easily and cheaply enlarged than a sea-level canal, and that the greater facilities for navigation which might possibly be afforded by the larger scheme would, owing to the lake navigation offered by the other, be so insignificant as not to justify the additional cost, delays, and uncertainties the construction of a sea-level canal would entail.

Since the above article was written, the Advisory Board of Engineers has by a majority of three recommended the construction of a sea-level canal, three American and five foreigners voting in favour of it, and five Americans against, giving the preference to a canal with locks; but the report of the Board has not yet been published.

THE BIOMETRICS OF BRAIN-WEIGHTS.

"We are not endeavouring to discredit anthropology, but to furnish such branches of it as anthropometry and craniology with new tools—a little sharp-edged to the uninitiated who handle them incautiously—but which will raise anthropometry and craniology in the future into the category of the more exact sciences" (Karl Pearson, *Biometrika*, vol. iii., p. 153, 1904).

"There is a mathematical science of statistics which must be learnt, and papers dealing numerically with anthropometric and craniometric data which do not now apply this theory are simply outside the field of science" (*Biometrika*, vol. iii., p. 397, 1904).

It is not a raid, but a victorious invasion, that Prof. Karl Pearson and his school have made into the realms of anthropology, with the result that all that part of it which deals with men in the mass becomes an annex of the mathematician. The invasion occurred at a most opportune time; great collections of data which had been accumulated by the anthropologist threatened to bury him, for he had neither the method nor the appliances for welding them into a composite whole. Especially was this the case with the endless measurements of brain-weights obtained most laboriously by the anatomist and pathologist; they urgently required an application of the "mathematical science of statistics." Hence the series of articles which occupy the greater part of a number of

Biometrika[1] published a few months ago are particularly welcome; they lay a foundation for an exact knowledge of this subject.

For a hundred years and more anatomists have sought to establish a formula by which the mental ability of any individual could be predicted from an examination of the head or brain. The problem was found to be beset with difficulties and extremely complex. How was mental ability to be standardised and measured? Is the ability shown by any individual a fair and full manifestation of his endowment, or may it be presumed that much is latent and potential? Are all the nerve structures within the cranial cavity equally concerned in the manifestation of a simple mental process, or is the organ of the mind confined to a part or parts of the brain? At an early date it was discovered that the size of the mammalian brain depended to a considerable extent on the size of the body; age and sex, too, were found to influence its weight. The weight of the brain was found to vary widely from individual to individual without any evident relationship to mental ability, so that most scientific men came to share the opinion of the unscientific, that neither the shape nor the size of the head, the volume or weight of the brain, could provide any but the most uncertain indication of mental status. Those who sought a key in the arrangement and complexity of the convolutions have not been more successful. Yet the belief that there is a close relationship between the relative size of the brain and degree of intelligence cannot be abandoned, for it is founded on a study of comparative anatomy. Amongst primates, for instance, it is found that those members which most nearly approach man in size and complexity of brain also most closely resemble him in their mental processes. It is probable, as suggested by Prof. Ray Lankester (NATURE, p. 624, April 26, 1900), that the increase in brain-weight is correlated with the substitution of voluntary or conscious for reflex, instinctive or automatic mental processes, or, in other words, the increase of brain-weight which is seen in the highest primates is the substratum of that mental quality which he has named "educability"; there is also the widespread belief that eminent men have relatively large heads. An examination of the heads of sixty distinguished men led Dr. Beddoe to the conclusion that "Intellectual distinction is generally the concomitant of largeness of brain, though there are numerous exceptions" (*Journ. of the Anthropological Institute*, p. 277, 1904). The method by which Dr. Beddoe sought to establish a correlationship between intelligence and skull capacity is regarded by Lewenz and Pearson as "quite fallacious. To begin with he selects a formula—by guesswork—which is theoretically incorrect" (*Biometrika*, p. 392, vol. iii., 1904). To sum up, anthropologists have not been able to establish, by the methods commonly in use, that there is any direct connection between the size of brain and special manifestations of human intelligence.

Turning now to the biometricians, their conclusions have the advantage of being founded on extensive collections of data, and reached by methods which are mathematically sound. In the number of *Biometrika* cited at the commencement of this article, Dr. Raymond Pearl gives the results of a biometrical analysis of 2100 adult male and 1034 adult female brain-weights, belonging to five races, Swedish, Bavarian, Hessian, Bohemian, and English. Although the matter was only a side-issue in his investigation, he sums up his conclusion as to the correlationship between brain-weight and intelligence thus:—"There is no evidence that brain-weight is sensibly correlated with intellectual ability. The limits of this correlation have been shown to be not closer than 0 and ±0·6." Here are the conclusions of other biometricians:—"There is no marked correlation between skull capacity and intellectual power" (Dr. Alice Lee). "We find the correlation sensible but so small that it is impossible to base any prediction from the size of the head as to general intelligence" (Lee, Lewenz, and Pearson, quoted from *Biometrika*, p. 392, vol. iii., 1904). There are certain circumstances, too, which must be taken into account. From about the age of twenty onwards the weight of the brain gradually decreases, a diminution which is not, as a rule, accompanied by a decrease of intelligence. Nor does the mean brain-weight of a race correspond to the mean intelligence of that race. Of the five races investigated by biometricians, the English have the smallest mean brain-weight. The mean of the adult Englishman is 27 grams less than the Bavarian mean, 57 grams less than the Hessian mean, 65 grams less than the Swedish mean, and 120 grams less than the Bohemian mean. "The order of racial average brain-weight is very far from the order of average racial intelligence. Nor is the order bettered if we allow in any manner for stature" (Blakeman). On the data at present available, one must come to the conclusion, apparently anomalous, that a big brain, so far as the manifestation of intelligence is concerned, has very little if any advantage over a small brain. The explanation of that anomaly lies with the experimental physiologist and psychologist. Meanwhile it is well to remember that under the title of brain-weight is grouped a complex of organs which are diverse in structure and in function.

If there is so little correspondence between brain-weight and brain-function the apparent preponderance of the man's over the woman's brain in weight and size loses much of its significance. It is now possible, thanks to the labours of the biometricians, to speak with a degree of accuracy and assurance as to the extent of that preponderance. The sexual difference in mean brain-weight is least among the English; the preponderance of the male in England is 100 grams (Pearson, from combined data) or 103 grams (Blakeman, from Gladstone's data); in Hesse 132 grams, in Bavaria 142 grams, in Bohemia 144 grams, in Sweden 147 grams, and in France 181 grams. In round numbers, the male preponderance is from 8 per cent. to 13 per cent. Amongst gorillas the male preponderance is 17 per cent., amongst orangs 13 per cent., amongst chimpanzees 6 per cent., and amongst gibbons 8 per cent., so that the human sexual differentiation is approximately an average amount for a higher primate. How far is the male preponderance due to greater body size? The conclusions reached by biometricians are the following:—"Differences in stature and age account for less than one-third of the observed sex-difference in brain-weight" (Raymond Pearl). "On the whole, as far as present evidence goes, we can safely conclude that there is no sensible *relative* difference in the brain-weights of man and woman, the absolute differences observed are quite compatible with the differences which result from the relative sizes of the two sexes. . . . While our results thus apparently contradict those of Pearl on p. 51 of this Journal (*Biometrika*, vol. iv., 1905) the contradiction is only on the surface, for we have been able to use a far more complete system of physical measurements" (Blakeman, Lee, and Pearson). Yet if the writer has rightly grasped the

[1] *Biometrika*, vol. iv., parts i. ii., June, 1905, (1) "Variation and Correlation in Brain-weight," by Dr. Raymond Pearl (with twenty-three diagrams in the text); (2) "A Study of the Relations of the Brain to the Size of the Head," by Dr. Reginald J. Gladstone (with plates ii., iii., and five figures in the text); (3) "On the Biometric Constants of English Brain-weights," by Mr J. Blakeman, assisted by Miss Alice Lee and Prof. Karl Pearson, F.R.S. (with six figures in the text).

methods used, the difference between the results is due to the fact that in his calculations Pearl took into consideration merely age and stature, while the second group of workers added a third, namely, the diametrical product—a quantity which roughly represents the size of the head. To the writer, who is a professed anatomist but not an expert mathematician, it seems that one must infer from these results that nearly two-thirds of the preponderance of the male brain is correlated with the greater size of the male head, while less than one-third is correlated with the greater size of the male body, using stature as a criterion of size. Clearly, if the writer's interpretation is correct, the cause of the relatively greater weight of the male brain is still to seek, for it will be readily granted that a greater brain must be correlated with a greater size of skull. The writer is prepared to believe that the relatively greater weight of the male brain is not only correlated with, but actually dependent on, the physically greater development of the male body, for amongst the various genera of anthropoids the sexual difference in brain-weight corresponds very closely to the sexual differentiation in body size.

To what extent, then, is the weight or size of the brain influenced by the bulk of the body as measured by stature or weight? Broca *was of opinion* that each addition of 10 cm. to the stature was accompanied by an addition of 5 grams to the weight of the brain; Marshall estimated the amount at 2·4 grams.[1] "In the Swedish males, an increase of 10 cm. in stature connotes an increase in brain-weight of 28·59 grams" (Raymond Pearl); the corresponding amount in English males is estimated by Blakeman at 38·69 grams. Dr. Pearl states that the addition of 16·5 kilos. to the body-weight has the same connotation as the addition of 10 cm. to stature. In biometrical terms, the regression is linear. Such is the conclusion which must be drawn from the human data at present available; but one may legitimately infer from the limited data provided by comparative anatomists[2] that it will ultimately be found that equal additions to the bulk of the body are attended, not by equal increments to the brain-weight, but that each successive addition to the body-weight is attended by a relatively smaller increase in the brain-weight. Manouvrier found that in passing from small to medium-sized dogs the addition of each kilogram to the body-weight was attended by the addition of 2·5 grams to the brain-weight; the increment in passing from medium-sized to large dogs 1·7 grams, and from large to very large dogs 0·7 gram. Marshall concluded from Boyd's data that a somewhat similar relationship exists between the body- and brain-weight in man. Gladstone has arranged measurements made on the heads of 363 Englishmen, belonging to all classes, in four groups, according to stature, and has given the mean diametrical product for each group. The diametrical product, as Mr. Blakeman demonstrates, gives only an approximate indication of the weight of the brain; but, allowing for that, it is still remarkable that the addition to the diametrical product steadily decreases as one passes from the lower to the higher stature groups. There is also direct evidence in favour of this opinion. Levi has demonstrated that the only cells in the body which show a marked correlation in size with the bulk of the animal are the ganglion nerve cells; but the relationship is such that we must infer that every further increment to the body-weight is attended by a diminished addition to the size of the nerve cells. If the cerebral nerve mass is regarded as the governing system of the body, then one would not expect that each addition to the body-weight would be attended by the same increment to the brain-weight any more than every subsequent million added to the population of a country requires an equal addition to its administrative service.

That there is a diminution in brain-weight in old age has been accepted as a truth for many years, but until now the rate of the diminution, the periods of life at which it occurs, and its exact amount have been undetermined. Pearl found that "after the age 15–20 there is a steady though very gradual diminution in the weight of the brain with advancing age. . . . In the Swedish males, an increase of ten years in age connotes a decrease of 19·39 grams in the brain-weight." In English males, from the data provided by Gladstone, Blakeman found that the brain lost 21·97 grams each decade. Not only does the brain decrease in weight, but the head shrinks in all its diameters—at least in our English "general hospital population." The head shrinks more in height than in length or breadth; the writer has observed that the skull of the cat and the gibbon shrinks in its vertical diameter as the animal becomes aged.

The brain reaches its maximum weight at a remarkably early period. Boyd, Vierordt, Marchand, Ziehen, and Gladstone found that the heaviest brain-weights occur between the ages of fifteen and twenty, but their conclusions rest on a narrow and uncertain basis; there is a remarkable dearth of observation on the weight of the human brain between the fifteenth and twenty-fifth years. During that period the body is increasing in size; Powys found that the maximum stature occurred early in the twenty-eighth year (*Biometrika*, vol. i.); since there is a correlationship between brain- and body-weight, there ought, therefore, to be an increase in the size of the brain so long as the body continues to grow. Clearly Blakeman and his collaborators, when they exclude all subjects under the age of twenty-four, are inclined to believe that the brain reaches its prime at a later period than the material at their disposal showed. They conclude that, so far as the weight of the body organs is concerned, there is apparently not a *period*, but only an *instant* of prime. Not more surprising is the result that the brain shrinkage is gradual; one would have expected a more rapid decrease after the ages at which Huxley proposed man should be pole-axed and Osler suggested the application of chloroform.

Much of the labour of the Pearsonian school was undertaken with the view of obtaining a method by which the size or weight of brain could be calculated with a sufficient degree of accuracy in the living subject. With that end in view, they have worked out on the data provided by Gladstone the correlationship of brain-weight with eight physical characters of the body, and found that the circumference of the head and the *diametrical product* (obtained by multiplying the length, breadth, and height diameters of the head) were those which were most closely correlated with brain-weight. Their prediction formulæ (multiple regression equations) are founded on the diametrical product and circumference, with deductions or additions for stature and age. These formulæ are applied to the head of Jeremy Bentham, to a skull reputed to be Dante's, and to "one of ourselves, P." The reputed Dante is found to have a probable brain-weight which is 80 to 90 grams below the mean of the English "general hospital population" (1328 grams); Bentham, a brain which was only a few

[1] See Keith, "The Growth of Brain in Man and Monkeys" (*Journ. Anat. and Physio.*, vol. xxix., p. 288. 1895).

[2] Eugen Dubois, "Ueber die Abhängigkeit des Hirngewichtes von der Körpergrösse bei den Säugethieren" (*Archiv f. Anthrop.*, Bd. xxv., 1899; *see also* Keith, *loc. cit.*)

grams above the English mean; while "P's brain-weight is essentially mediocre." By the use of these formulæ the brain-weight can be predicted in the living with a probable error of 50 grams. "Nothing better can probably be achieved by introducing further external characters, or by considering regression as curved instead of plane."

Looking widely at the labours of the biometricians on human brain-weights, they appear to the writer, who views them as an anatomist rather than a mathematician, to have accomplished three things:—They have fixed accurately the mean brain-weights for five subraces of Europeans, and shown that mean brain-weight is a racial character; they have estimated by a definite standard the degree to which the brain varies in size and weight according to the individual, the sex, and the race; they have worked out the extent to which various features of the head and body are correlated with the weight of brain, and expressed them in definite and permanent terms. They have laid a sound foundation for future statistical work on this subject, and yet, even at the risk of appearing ungracious, it is the writer's opinion that the full explanation of the relationship which exists between intelligence, brain-weight, and other characters is more likely to be discovered by those who investigate the individual than by those who study the mass.

THE HEAD-HUNTERS OF BORNEO.[1]

WITHOUT making any pretence to being scientific, this plain and unvarnished, but eminently readable, narrative of a lady's experiences among the natives of some of the more remote districts of the interior of Borneo contains a large amount of interesting information with regard to the customs and mode of life of both Dyaks and the less well known Muruts. Mrs. Cator, it appears, accompanied her husband on his official trips into the interior of that wonderful island, and during these underwent experiences and faced difficulties such as few ladies would care to repeat, and which afford incontestable testimony as to her pluck and resolution. Among these experiences it will suffice to refer to the account of her sleeping with her husband in a large shed in company with a long row of savage head-hunters who had never before beheld a white woman, or, for that matter, a white man.

FIG. 1.—Head-hunters at Kaningau. From "Everyday Life among the Head-hunters."

FIG. 2.—Head-hunting Chief and his wife with the bamboo water-cans they always use. From "Everyday Life among the Head-hunters."

It is, indeed, the portion dealing with the Muruts, or head-hunters, of the interior that forms by far the most interesting section of Mrs. Cator's volume, and the one which will appeal most strongly to ethnologists. The Muruts, according to the author, are a dark race compared to other races of the interior, and have certain customs peculiar to themselves, the preparation of a specially deadly form of the celebrated upas poison being one of their attributes. Although the Dyaks, except where under strict European control, are enthusiastic head-hunters, they preserve only the scalp and hair of their victims, scalp after scalp being added to their krisses with great pride. The Muruts, on the other hand, carry off and preserve the whole head as a proof of their prowess, their houses being frequently decorated with these ghastly trophies, which the author saw on more than one occasion suspended above her sleeping-place. "But there is nothing revolting in their head-hunting," writes Mrs. Cator; "they fight fairly. It is their chance of winning renown and showing what they are made of. The only low part of it is that a woman's head, owing to her longer hair, is prized even higher than that of a man; but the whole thing is a thrilling game to them, full of excitement and danger. There is nothing unfair in their warfare; both sides are doing the same, and man after man wins his spurs in feats of pluck and daring."

Despite the truculent character of their head-hunting

[1] "Everyday Life among the Head-hunters; and other Experiences from East to West." By Dorothy Cator. Pp. xiv+212; illustrated. (London: Longmans, Green and Co., 1905.) Price 5s. net.

forays, the Muruts, when not thus engaged, struck the author as being exceedingly gentle and extraordinarily peaceful in their home life, so much so, indeed, that during the whole of her sojourn among them not a single "family jar" was witnessed. Although, like most Malays (in the wider sense of that term), the Muruts are somewhat indolent in their nature, yet they collect considerable quantities of camphor, and grow such agricultural and garden produce as is required for all their wants, inclusive of material for clothes, while they are accomplished hunters and fishermen.

We have directed special attention to the account of the Muruts, as being the most interesting in the volume; but all the chapters, including those relating to the west coast of Africa, are well worthy of perusal, and the book may be heartily commended to all our readers. R. L.

REPORT OF THE GEOLOGICAL SURVEY.[1]

WE are glad to welcome the annual report of the director of the Geological Survey upon the work carried on by his staff and himself during the year 1904. It gives not only an account of the areas surveyed and the maps issued, but affords an insight into the new methods of research rendered possible and necessary by the advance of scientific knowledge. It is clear that, although maps showing the distribution of the rocks over the whole of the British Isles have been published, the survey is by no means complete, nor do we see that it can ever be considered as complete until all the resources of scientific investigation can be pronounced to be at an end. With regard to the maps themselves, much of the earlier work was put upon maps published as far back as 1819. Chemistry and physics, the appliances at the disposal of the petrologist, and the knowledge acquired by the palæontologist are all advancing with rapid strides, and we see on reading such a work as the annual report of the director of the Geological Survey how they are all brought to bear upon the economically important questions of identification of strata and utilisation of the resources buried in the earth.

One cannot often walk over the ground and detect at once what is of value in it, but a knowledge of the association of minerals may tell one that a certain vein may lead to a metalliferous lode. Hard earned experience and a well trained eye recognise a band of rock containing certain varieties of plants or animals. It may be itself of no use commercially, but yet be of the greatest value economically if it has been ascertained that it occurs in constant relation to some other stratum which is of value. Thus we find on p. 5 of the summary that "the search for coal beneath the Triassic rocks of the Midlands which has been going on for many years and is likely to continue, has brought into great prominence the importance of an accurate knowledge of the subdivisions of the upper unproductive measures"; and again, p. 11, "A seam of coking coal has been worked to the south-east of Alton. The depth and other details have not yet been ascertained, but fossils, similar to those got by Mr. Wedd in the brickpits at Bullbridge, Ambergate, have been obtained from the tip heap, and it is hoped that their distinctive character may enable this seam to be traced over a considerable area."

When we bear in mind that the discovery of one good seam of coal would probably repay the country the cost of maintaining the survey for many years, let us hope that it will be one of the last institutions affected by any policy of retrenchment.

The first object in founding the survey, and the school and museum then wisely connected with it, was the promotion of scientific research with a direct aim at economic and practical results, and every page of the report before us tells how admirably this object is being carried out. The surveyors note the occurrence and character of the various building materials met with—the stone, brick, and cement produced in various localities; they record where road metal may be procured and discuss the sources of water supply, a subject which, having regard to its importance, might well have a strong staff told off for its investigation.

We find in the text or in an appendix useful analyses of various rocks and minerals, descriptions of methods of dressing ores, and a discussion of the conditions which affect the search for coal-bearing strata which are covered over by immense deposits of later date and irregular occurrence.

It is clear that no one can tell beforehand what will be directly productive of economic results in such investigations as lie before the geologist, and the country demands the encouragement of scientific research and the pursuit of knowledge even where no one could foresee any practical results. We find that the survey does take cognisance of the physical geography of each district examined, its ancient lines of drainage, its raised beaches, and also investigates many difficult questions of chemical, thermal, and mechanical metamorphism, and the petrology and palæontology of rocks not obviously productive of anything of commercial value. The treatment of all these questions is arranged first of all geographically, so that anyone may turn to the description of his own district, and then stratigraphically, and the names of those who are responsible for the different statements are given in the margin. When we realise that this is the report of one year's work, we may look forward to the development of the summary into valuable treatises of great practical and scientific value.

[1] "Summary of Progress of the Geological Survey of the United Kingdom and Museum of Practical Geology for 1904." (London: Printed for H.M. Stationery Office by Wyman and Sons.) Price 1s.

NOTES.

AT a meeting of the Röntgen Society on Thursday next, January 4, Prof. F. Soddy will deliver the presidential address upon "The Present Position of Radio-activity."

THE death is announced of Mr. F. W. Burbidge, curator of the botanical gardens of Trinity College, Dublin. From a short obituary notice in Wednesday's *Times* we learn that Mr. Burbidge was born in Leicestershire in 1847, and, after studying horticulture at Chiswick and at Kew, afterwards combined a good deal of experience as a practical gardener with some adventurous journeys to Borneo and the East Indies as a collector of birds and orchids. He was appointed in 1879 to be the curator of the gardens at Lansdowne Road, Dublin, which belong to the Board of Trinity College, and are attached to the scientific side of the college. He filled his office with distinguished success, and made many important contributions to the literature of his subject, on which he was a recognised authority. He was a member of the Royal Dublin Society and of the Royal Horticultural Society, and in 1889 the University of Dublin conferred upon him the degree of Master of Arts, *honoris causa*. In addition to many articles in periodicals, Mr. Burbidge was the author of several books upon horticultural subjects.

AT a recent meeting of the Wellington Philosophical Society, as reported in the Wellington *Evening News* of November 4, an important discussion took place with re-

gard to the alleged sheep-killing habit of the New Zealand kea parrot. As is well known, this bird is commonly reported to cause the death of sheep—or to leave them in such a condition that death soon ensues—by pecking a hole in the side, and the alleged habit is accepted as a fact in ornithological and other natural history works. According, however, to investigations undertaken independently by a number of New Zealand gentlemen, the story is without a shadow of foundation. The observers included naturalists and estate agents, as well as others whose judgment must be regarded as equally trustworthy. The kea is a bird of unbounded curiosity, and it is suggested that the myth is probably due to this habit, some observer who had seen a kea inspecting the carcase of a defunct sheep or lamb having very likely jumped to the conclusion that the bird was the active cause of the animal's death. It is concluded that although the legend cannot be said to be completely disproved, yet there is not a scrap of evidence in its favour. Owing to its bad repute, the kea is in imminent danger of extermination.

The ornithology of Oxfordshire, by Mr. Aplin, and notes on fishes taken at Yarmouth, by Mr. A. H. Patterson, are the subjects of the two articles in the December issue of the *Zoologist*. Mention of several birds new to the British list or of very rare occurrence in our islands is made in the notes column, the two new forms being the yellow-breasted bunting, from Norfolk, and the dusky thrush, from Nottinghamshire. A correspondent publishes a photograph of the skeleton of the fore-feet of a polydactyle cat, displaying duplication of the thumb on one side, and triplication on the other. Almost exactly similar conditions obtain in the feet of two such abnormal cats exhibited in the Natural History Museum.

The December number of the *Naturalist* contains new regulations for the local protection of birds promulgated by the county councils of the North, East, and West Ridings of Yorkshire in response to a petition presented by the Naturalists' Union of the county. Among the more noticeable items are the extension of the close time for a previously scheduled list of species, the period now being from the last day of February to September 1; the total prohibition of the killing of a number of species mentioned in a second list for a period of five years; and total protection for a similar period of the eggs of a third list of species. Wild-bird shooting is entirely prohibited on Sundays, while two proclaimed areas are to be protected for a further five years. It is added that, in response to an appeal from the Union, the Bridlington Harbour Commissioners have prohibited the practice of firing at the birds on Bempton and Speeton Cliffs from passing pleasure-steamers.

Museum News (Brooklyn, New York), No. 5, opens with a dissertation on the proper mode of visiting museums, that is, in order to derive some benefit therefrom. Type descriptions of two exhibits are appended, one dealing with the eggs of the brant-goose and the other with the manati. The latter, we should say, is an excellent example of what a museum descriptive label ought *not* to be, for while manatis, dugongs, and rhytinas are all referred to, there is not a word to indicate how they are to be respectively distinguished. A novel practical exhibition—desirable or otherwise—has been added to the Children's Museum in Bedford. In a vessel of water are placed a few coins with an invitation to take one; but the coins remain, for in the water are a couple of charged wires, from which a severe electric shock is received.

Four papers on Cretaceous reptiles are included in the December number of the *American Journal of Science*. The two first of these are devoted to a couple of new representatives of horned dinosaurs (Ceratopsia) from the Laramie beds of Wyoming, discovered by the late Mr. J. B. Hatcher, for one of which the finder proposed the name *Triceratops brevicornis*, while to the second, which lacks the single nasal horn, Mr. R. S. Lull gives the new generic and specific title *Diceratops hatcheri*. A figure of a restored model of the head of the latter shows a creature strangely like a rhinoceros, save for the rudimentary condition of the nasal horn and the presence of a pair of horns above the eyes. We have now evidence of the existence of either one, two, or three functional horns in the Ceratopsia—features correlated by Mr. Lull with differences in the mode of attack of these giant reptiles. The one-horned form is supposed to have attacked in what the author describes as rhinoceros-fashion, *i.e.* with an upward thrust. Mr. Lull, however, appears to be unaware that neither of the Asiatic one-horned rhinoceroses uses its horn for fighting, but relies solely on its tusks! A mounted skeleton of a third species, *Triceratops prorsus*, in the U.S. National Museum, forms the subject of an illustrated paper by Mr. C. Schuchert. The fourth of the aforesaid series of reptilian papers is the first of a series by Mr. G. R. Wieland on Upper Cretaceous turtles, the forms dealt with in this instance being the small but thick-shelled Adocidæ (Adocus and Agomphus). The thickness of the shell may have been correlated with sublittoral habits as a protection against predatory dinosaurs.

The four latest issues of the *Proceedings of the U.S. National Museum* comprise the description by Miss Richardson of a new species of the crustacean genus Livoneca from Panama (No. 1430); an account of the breeding habits and the segmentation of the eggs of the Florida pipe-fish (*Siphostoma floridae*), by Mr. E. W. Gudger (No. 1431); notes on exotic earwigs, with descriptions of new species, by Mr. J. A. G. Rehn (No. 1432); and a list of fishes collected at Shanghai and Hong Kong in 1882–3, by Messrs. Jordan and Seale (No. 1433), containing descriptions of half a dozen species regarded as new to science. In the above-mentioned paper on the Florida pipe-fish, Mr. Gudger gives a detailed summary of the history of our knowledge of the breeding habits of pipe-fishes and their kindred, and then discusses those of the species under consideration. In all these fishes the ripe eggs are transferred from the oviducts of the female to a special brooding-pouch on the under-side of the abdomen of the male. In the case of the Florida species, when the eggs are ready for transference the male and female fishes swim round and round one another for a time, and then intertwine their bodies in the form of a double letter S, with the heads of each turned outwards. In this position the eggs are transferred from the ovary of the female to the pouch of the male, where the two are in contact, about a dozen eggs being received in the pouch, where they are presumably fertilised. The male then performs a series of evolutions for the purpose of "shaking down" the eggs into the end of the pouch, on the completion of which the process of transference is resumed. The eggs, which soon become fixed to the pouch, are hatched in ten days. Full details, with illustrations, are given of the segmentation.

The first appendix to the *Kew Bulletin* for 1906 has put in an early appearance; it contains a list of seeds of hardy herbaceous plants, and of trees and shrubs available for exchange with botanic gardens or regular correspondents of Kew.

It has been recognised that in the case of the wintergreens, species of Pyrola, the seedlings possess some undiscovered peculiarity. In 1882 Kamienski described for the allied genus Monotropa the formation of a thread-like body out of which the flowering shoot arose. Ten years later Prof. J. Velenovsky announced that from the seed of Monesis, or *Pyrola uniflora*, there develops a primary body, a *procaulom*, from which the leafy shoot develops endogenously. Recently he has published an account of the seedlings of *Pyrola secunda* in the *Bulletin international de l'Académie des Sciences de Bohême*, October, in which he confirms his previous conjectures.

Farmers in New Zealand are well instructed by the Department of Agriculture as to the wisdom of exterminating weeds, so that a discussion of the weed habit in plants by Dr. L. Cockayne, published in the *Canterbury Agricultural and Pastoral Association's Journal*, October, has its special interest. On cultivated lands the weeds are mostly aliens, but a number of indigenous weeds are spreading over pasture lands in different parts; they include *manuka* scrub, Leptospermum, cotton wood, *Cassinia leptophylla*, plantains, and species of Acaena that are distributed by means of their hooked burrs. The indigenous grass *Danthonia semiannularis* is a rare instance of an aggressive plant that possesses economic value.

As a point of some importance in connection with the stage at which grasses should be cut for fodder, Mr. H. H. Cousins gives in the *Jamaica Bulletin* (October) the results of chemical analyses made at different times. In the case of hay grass, *Sporobolus indicus*, cut after two weeks' growth, the albuminoids amounted to 10 per cent. of the dry weight, whereas after four weeks they barely reached 6 per cent.; a marked difference was also found in the hay of guinea grass, *Panicum maximum*, cut before flowering or during the fruiting stage. In the same number, in the course of a report on cocoa cultivation, Mr. Cradwick questions whether "fiddler" larvæ can attack undamaged and healthy trees; on this matter there appears to be a difference of opinion.

In St. Lucia, according to the annual report for the year 1904–5 of the botanic and experiment stations, cacao planters are beginning to learn from the successful results shown on the experimental plots that a greatly improved yield can be obtained by systematic manuring and intense cultivation. Among products of secondary importance, the dwarf or Chinese banana, *Musa Cavendishii*, is receiving a trial, and the cultivation of vanilla is recommended. Mr. Hudson, the agricultural instructor, writing on the subject of supports for vanilla plants, selects the Liberian and a wild coffee plant, or the annatto, *Bixa orellana*, as the most suitable.

The annual report for the year 1904–5 of the Board of Agriculture in Jamaica contains an account of numerous experimental plantations at Hope Experiment Station for testing varieties of bananas, plantains, cassava, tannias, citrus fruits, pineapples, and sweet potatoes. Of these crops cassava is of special importance, as it could be cultivated profitably on much land that is now lying waste, if central factories were erected for the purpose of manufacturing starch. In addition to the experimental plots, where sixty varieties of cane are on trial, the sugar industry is likely to benefit greatly by the central laboratory which is to be constructed. This will contain a room fitted up for analytical work, a fermentation laboratory, and an experimental distillery.

It is becoming more and more evident that, even in minor earthquakes, the focus may be much more complex than the simple fissure or cavity accepted by earlier seismologists Dr. C. Davison has familiarised us with twin foci in the small earthquakes of the British Isles, and now we have an account, by Dr. S. Arcidiacono, of Catania, in the *Bolletino della Societa Sismologica Italiana*, of the Sicilian earthquake of June 14, 1904, which, though nowhere more than a feeble shock, showed no less than four separate centres of maximum intensity.

A pamphlet issued by Pre. Raffaello Stiatteri, from the geodynamic observatory of Quarto Castello, near Florence, deals with the determination of the distance of the epicentre of an earthquake from the duration of the preliminary tremors. He finds from his own observations that, for epicentres not more than 2000 km. distant, the distance in kilometres is 5·63 times the duration of the tremors, expressed in seconds. Prof. Omori, working in Japan, deduced a similar formula, but his factor was 6·54 for the same limit of distance. This is attributed, with what seems sound reason, to a difference between the constitution of the earth's crust under central Europe and that under the sea east of Japan; but the possibility is indicated that the difference may be partly attributable to Prof. Omori's instruments being less adapted for picking up the earliest tremors than those built and used by the Abbé Stiatteri since 1902.

At Detroit, Michigan, large deposits of salt underlie the limestone and sandstone at a depth of 1500 feet. Boreholes have been put down through which brine has been pumped; but up to a year ago all attempts to sink shafts to mine the salt have proved failures owing to the sulphur and gases encountered. On February 20 a new shaft was begun, and has been successfully carried to the salt. Illustrations given in the *Engineering and Mining Journal* show that a crib was employed made of 12 by 12-inch timbers bolted together and made absolutely water-tight. This was forced from the top downwards to the salt, Portland cement being used between the crib and the rock. Two powerful ventilating fans were used for driving out the gases; but even then men could only remain in the shaft for a very short time without losing consciousness.

The last issue of the *Transactions of the Nova Scotian Institute of Science* (vol. xi., part i.), although somewhat belated in publication, records a year's useful scientific work. The most important paper contributed is that by Prof. J. E. Woodman on the geology of the Moose River gold district in Halifax county. It formed part of an investigation into the pre-Carboniferous history of the gold-bearing series. The gold occurs in sedimentary deposits and in veins. In the former it is held chiefly in slates, almost all being in the form of sulphides. In the quartz veins, however, a large proportion is free within the zone of oxidation, and a small amount below it. Detailed descriptions of the veins are given, and the paper is accompanied by eighteen admirable maps and illustrations. Other papers deal with sections and analyses of Nova Scotian coals, by Dr. E. Gilpin; contributions to the study of hydroxylamine and its salts, by Mr. W. H. Ross; and details of about forty fungi determined by Mr. R. R. Gates from the vicinity of Middleton, in Annapolis county.

The Engineering Standards Committee has issued, in the form of a pamphlet of sixty pages, a report on progress of work from January, 1901, to July, 1905. Originally formed with the object of standardising steel sections, its scope has since been greatly enlarged. The subjects dealt

with up to the present time include :—rolled sections; railway and tramway rails; locomotives for Indian railways; pipe flanges; screw threads; pipe threads; limit-gauges; railway rolling-stock material; tire profiles; steel castings and forgings for marine work; Portland cement; cast-iron pipes; generators, motors, and transformers; prime-movers for electrical purposes; physical standards; telegraph and telephone material; electric cables; electric tramway materials; electric automobiles; and electric plant accessories. The report recounts the results of the labours of the committee, and includes a list of the members serving on the thirty-five sectional committees, as well as a list of the publications issued. It is impossible to exaggerate the value of the work done, and the thanks of all engineers are due to the five technical societies who supplied the funds to inaugurate a work of such national importance.

WE learn from the November number of *Das Wetter* that the highest kite ascent on record was made at the aëronautical observatory at Lindenberg (Prussia) on November 25, an altitude of 21,100 feet being attained. In this ascent six kites were attached to each other, with a wire line of nearly sixteen thousand yards in length. The minimum temperature recorded was $-13°$ F.; at starting the reading was 41°. The wind velocity at the surface of the earth was eighteen miles an hour, and at the maximum altitude it reached fifty-six miles an hour. Up to the time of this ascent the highest record by a kite was nearly 1100 feet lower, and was obtained by M. Teisserenc de Bort, from a Danish gun-boat, in the Baltic.

THE Journal of the Meteorological Society of Japan for October contains an article (in French) on the rainfall of Chemulpo. The Japanese observatory was only established in April, 1904; the observations on which the present paper is based were made by the Corean customs officers during eleven years, 1893–1903. The mean annual rainfall is 38 inches, of which 7·7 inches fell in July; 53 per cent. of the total amount fell in three summer months. The average number of rain-days is 89. The heaviest rainfall during one hour was 0·85 inch, in August, 1901. The average duration of rainfall is about six hours, the longest falls being in springtime.

WE have received from Dr. Hergesell, president of the International Aëronautical Committee, a summary of the ascents made during the four months May to August, in various countries, by kites and balloons. Only the heights reached are quoted—not the meteorological results, which will be published later on. The unmanned balloons obtained several records at heights exceeding 15,000 metres in each of the months :—in May, 18,490 metres, at Munich; in June, 20,620 metres, at Munich; in July, 20,000 metres, at Munich; on August 3, 25,800 metres, at Strassburg; on August 2, 15,230 metres, in the Atlantic, on the Prince of Monaco's yacht. In connection with the solar eclipse, ascents were made on the three days August 29–31. On the day of the eclipse, an altitude of 23,010 metres was reached at Munich. During the month of August several kite ascents were made in the North Sea by Mr. G. C. Simpson, under the auspices of the Royal Meteorological Society, and some valuable results were obtained, both as to temperature and humidity.

LORD BLYTHSWOOD and Mr. H. S. Allen contribute to the *Philosophical Magazine* for October an interesting investigation of Dewar's method of producing high vacua by means of charcoal. It is shown that it is only necessary to increase the size of the charcoal receptacle in order to produce a high degree of exhaustion in a large discharge tube without the use of a pump. The method requires only moderate quantities of liquid air, and is particularly useful when it is desirable to avoid the presence of mercury vapour in the vacuum tube, as in the Geissler tubes used for spectroscopic analysis. A special investigation showed that the rate of absorption of the charcoal at any instant is proportional to the difference between the total amount of air absorbed and the amount which has been absorbed at the instant in question, that is, the rate is in a constant ratio to the quantity of air that will still be taken up by the charcoal. The constant is but little affected by alterations of the pressure under which absorption occurs.

THE residual electromotive force of the carbon arc is the subject of a paper by Mr. G. G. Becknell in the *Physical Review* (vol. xxi., No. 3). The circuit used was so arranged that the dynamo and galvanometer could be alternately joined in series with the arc gap, and it was found that the so-called residual current could be observed for more than ten seconds after the interruption of the arc. From the experiments it is concluded that the current can be attributed neither to a thermoelectric effect in the arc nor to one external to it. A description is given of the means by which the residual electromotive force and current are measured as functions of the time, and from the curves shown it is seen that the fall of the current is much more precipitate than that of the E.M.F., showing that the resistance of the arc increases very rapidly. An explanation is suggested by considering that a stream of corpuscles is freely emitted by both incandescent terminals, but more abundantly from the positive, and that these diffuse across the arc gap until the carbons have so far cooled down that the rate of production of the negative ions by the positive carbon no longer exceeds the rate of their production by the negative carbon.

MESSRS. F. VIEWEG AND SON have just issued a second revised and enlarged edition of Prof. F. Hofmeister's "Leitfaden für den praktisch-chemischen Unterricht der Mediziner," originally published in 1899.

MR. J. A. BARTH, Leipzig, has sent us a part of the second edition of the "Handbuch der Physik" edited by Prof. A. Winkelmann. This part is the first half of the fifth volume of the handbook, and in it Prof. F. Auerbach deals with electricity and magnetism. We await the remainder of the work before a review can be undertaken usefully.

MESSRS. A. GALLENKAMP AND CO., LTD., of Sun Street, Finsbury, E.C., are issuing a series of descriptive circulars giving full particulars of special arrangements of physical apparatus which they now make up for fundamental work in experimental science. The forms of apparatus have been carefully selected so that accurate results may be obtained by experiments with them.

NEW editions of parts of two valuable works on physics have lately been published by Messrs. F. Vieweg and Son, Brunswick. One is the first part of the first volume of the tenth enlarged and revised edition of Müller-Pouillet's "Lehrbuch der Physik und Meteorologie," edited by Prof. L. Pfaundler in cooperation with several other eminent German physicists and meteorologists. This part, by Prof. Pfaundler, contains the general introduction on the properties of matter, while the remainder is devoted to mechanics. The work will be completed in four volumes. The second part of the first volume of the seventh edition of Dr. J. Frick's "Physicalische Technik" has also been received. This work will be completed in two volumes, and notices of it and of the above mentioned treatise are best deferred until all the parts have come to hand.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c*.—The results of numerous observations of comet 1905*c* (Giacobini) are published in No. 4058 of the *Astronomische Nachrichten*. Observing at Bamberg on December 10, Prof. Hartwig recorded the magnitude of this object as 10·0 and its diameter as 2′.

The following is taken from an ephemeris published by Herr E. Strömgren in No. 4060 of the *Astronomische Nachrichten* :—

1905–06	α (true) h. m. s.	δ (true) ° ′	log γ	log Δ	Brightness
Dec. 28	16 31 10	+ 5 54·2	9·8601	0·0312	5·16
„ 30	16 46 19	+ 3 45·6			
Jan. 1	17 2 3	+ 1 28·6	9·7908	0·0192	7·51
„ 3	17 18 25	− 0 56·7			
„ 5	17 35 24	− 3 29·7	9·7020	0·0148	11·54

Writing in the *Daily Graphic*, Mr. Denning states that the comet is rapidly becoming brighter, and should become visible to the naked eye early next month. On January 6 the comet will be about fourteen times as bright as when discovered.

ECLIPSE SPECTRA.—At the meeting of the Paris Academy of Sciences held on December 11, M. Salet submitted further, and more detailed, results of the discussion of the spectrograms obtained by him during the recent eclipse of the sun.

Two spectroscopes were employed, the one arranged for photographing the visual part of the spectrum, the other, made up of quartz and Iceland-spar optical parts, for photographing the ultra-violet end.

The slits of the spectroscopes were adjusted so that they bisected the solar images produced by two heliostats and collimators. On the one side of the sun the slit cut through an important group of prominences, and the resulting spectrum shows a number of lines, including those due to H, Ca, coronium, and He, and a line at λ 4025 to which no origin has as yet been assigned. On the other limb of the sun the spectrum shows only the lines due to coronium and the H and K (calcium) lines.

Of all the lines found, M. Salet believes that only the coronium line is truly coronal; this extends to about 4′ above the sun's limb, but does not descend to it, whilst the lines of other elements are strongest next to the limb, and are much shorter than the coronal line.

Twenty-two lines have been measured in the ultra-violet spectrum obtained—which extends to λ 308, and is very rich in bright lines—and of these eight are coincident with strong titanium lines in the ordinary solar spectrum (*Comptes rendus*, No. 24).

IONISATION OF THE ATMOSPHERE DURING TOTAL SOLAR ECLIPSE.—The results of the researches on the ionisation of the atmosphere during the eclipse of August 30, which were obtained by M. Charles Nordmann at Philippeville, are published in No. 23 (December 4) of the *Comptes rendus*.

Until about forty-five minutes after the first contact, the curve registered by the ionograph was of the regularly increasing type, such as was obtained on every day when the sky was clear. But at that time an unusual progressive recession took place, culminating in a sharply marked minimum forty minutes after totality, and this was followed by a gradual increase in the ionisation until, at about twenty minutes after the last contact, the curve assumed its normal height.

It thus appears from this research that the solar radiation is one of the factors on which the ionisation of the atmosphere depends, a result which accords with the hypotheses formulated by Lenard, Elster and Geitel.

The amount of the "lag" of the ionisation curve behind the related eclipse phenomena is also in accordance with theory.

MEASURES OF DOUBLE STARS.—The Greenwich results of micrometer measures of double stars during the year 1904 are published in No. 1, vol. lxvi., of the *Monthly Notices*. The observers were Messrs. Lewis, Furner, and Bowyer, and the observations were made with the 28-inch refractor (28 feet focal length), a power of 670 being generally employed. About 430 stars were measured, some of them on several nights, and the table given shows the coordinates (1900), the position angle, the distance, the magnitude, and the epoch of the observation of each pair.

GRAPHICAL METHOD FOR FINDING THE TIME OF MOONRISE.—In No. 10, vol. xiii., of *Popular Astronomy*, Fr. W. F. Rigge, S.J., of Creighton University (Nebraska), gives and explains a set of curves which may be used for finding the times of moonrise and moonset, on any future date, employing a graphical method which he believes has not been previously published. Three curves are necessary, one to determine the time of the moon's meridian passage, the second to give its hour-angle, and the third to obtain the correction to the rising and setting, due to the moon's motion in right ascension.

The correct result is easily obtained to within an accuracy of one minute, and the author states that he is able to compute the times of both rising and setting, for a whole month, in less than an hour.

NEW BUILDINGS OF THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE.

THE first section of the new buildings of the Glasgow and West of Scotland Technical College was formally opened on Thursday, December 21, by the Right Hon. John Sinclair, M.P., Secretary for Scotland. The opening ceremony took place in the examination hall, and was attended by a large and representative assembly. The chairman of the governors, Mr. Wm. Robertson Copland, presided, and in introducing Mr. Sinclair gave several details that are of general interest. The part of the building now completed and occupied represented about 70 per cent. of the whole scheme, and even in its uncompleted state was the largest of the kind in Great Britain. The floor area of the completed part extended to more than 187,000 square feet, or about four and one-third acres; the corridors in the building measured more than a mile in length; and there were 828 windows which required one acre and one-third of glass to fill them. The cost of the completed part was 211,743*l*., and was fully met by subscriptions already paid or by sums about to fall in. Although all the principal classes were now accommodated in the new buildings, there were still several industrial classes—for decoration, furniture design, printing, lithographing, and the like—that would have to be conducted in rooms outside the college. It was also pointed out that since the demand for new buildings became clamant about ten years ago, the increase in the number of day and evening students combined had been about 50 per cent.; last session, 1904–5, the day students numbered 530 and the evening students 4490.

The Secretary for Scotland said it was a very high privilege to be associated in any degree with so important a work. Nobody who knew anything of Glasgow or the west of Scotland and looked round that assembly, both on the platform and before him, could fail to recognise that an occasion which brought together the leading men in so many different spheres of activity was an occasion of special importance. That fact had been emphasised by the figures which the chairman had given them in connection with the technical college, and it must be a special gratification to the governors of the college that public appreciation of their work was so evident in the attendance of leading men that afternoon. As he understood it, this great institution was specially fortunate in carrying on an ancient tradition—a tradition dating from Prof. Anderson, a man who seemed to have been curiously modern in some of his ideas; and it must be a source of strength to that institution that it had so venerable a tradition to support and so wide a field of modern activity. No one would dispute henceforth, if they had been inclined to dispute it hitherto, that Glasgow and the west of Scotland generally, in the erection of that great building, in the size and selection of the staff, and in the growing attendance of the students, had shown a lively recognition of the value of such work as was done in that institution. As the chairman had pointed out, the plans of himself and the board of governors had not been fully attained; he

was sure it was the hope of all present that support would soon be forthcoming to enable the plans to be completed. There was another kind of support equally essential for the progress of the institution—the appreciation of its benefits by those who enjoyed them. They had a guarantee for that in the manner in which the management controlled and guided the affairs of the college; for the governors were assisted by committees having a practical knowledge of the different trades affected, committees consisting of employers and employed, of masters and men. He was sure all those who had the privilege of knowing anything, however little, of this institution would have confidence that in the future as in the past it would meet with that public recognition which it so truly deserved. In closing, he declared the new buildings open.

The memorial stone of the new buildings of the Glasgow and West of Scotland Technical College was laid on May 14, 1903, by His Majesty King Edward, and in Nature, vol. lxviii., pp. 63, 64, a notice was given of the ceremony and also a sketch of the history of the college and an outline of the proposed scheme of new buildings. These will ultimately consist of five large wings, two parallel to George Street and three at right angles to them and parallel to Montrose Street; of these all except the principal portion of the front wing to George Street have been completed. The frontage to George Street will be 346 feet long, more than 100 feet in height, and will contain five floors and a semi-basement; the frontage to Montrose Street, 300 feet long, is shown in the annexed photograph. The plan of confining each department to one floor has been followed in nearly every case, and the internal arrangements generally are believed to be well adapted to efficient working. The figures given in vol. lxviii., p. 64, for the space allotted to each principal department represent very closely the dimensions in the completed part, and the equipment already provided has cost about 24,000*l.*; but additions to the buildings and equipment are urgently required, because, large though the premises are, they are inadequate for the accommodation of all the students of the college, and additional premises have still to be rented. G. A. G.

Photo. *Annan.*

Fig. 1.—Completed Part of the New Buildings of the Glasgow and West of Scotland Technical College.

RECENT STUDIES OF PERIODS IN METEOROLOGY.

In *Symons's Meteorological Magazine* for November (No. 478, vol. xl.) Mr. A. P. Jenkin contributes an interesting note on periodicity of rainfall. Dealing with the Greenwich data commencing in 1843, he finds that there is a three-year period of rainfall, which, however, at times suffers reversal. Thus for a series of years we shall have two wet years followed by a dry one, and for a subsequent series two dry years followed by one wet one. Mr. Jenkin finds that this result can be obtained by transforming an actual period of 3·2 years into a period of 3·0 years, reversals taking place at the end of eight periods, and he compares the values thus obtained with the Greenwich rainfall figures. The result is interesting. As regards the origin of this three-year period, he says the "apparent period of three years with reversals is a real period of between *three and four years,* which is just what Sir Norman and Dr. Lockyer have observed in meteorological phenomena in India and other widely separated parts of the earth. . . ."

Mr. Jenkin has apparently not seen the article which appeared in these columns in June last (vol. lxxii. p. 180), in which the relation between British pressure and rainfall changes and the Thames flow was discussed. The short-period British pressure variations (and consequently rainfall, since the latter is inverse to the pressure) were there shown to be intimately associated with the two main world-pressure types of those authors, as the following extract will show:—"During some years the British area is enveloped in the pressure system that extends over the large area in which India is about the centre, while for another series of years it is dominated by the antipodal pressure system of which South America is the middle portion."

"It is possible that it is this alternate reversion from one type to the other that prevents the 3·8-year change of the Indian and Cordoba curves from occurring in the British curves, and substitutes for it *an apparent shorter period of about three years,* which is very noticeable for some series of years in the British curves."

It will thus be seen that Mr. Jenkin has practically arrived independently at a similar conclusion. In the same note Mr. Jenkin deals with the Cape Town rainfall, which, as he says, shows the same result, though the number of periods in a series is six, and the time of reversal does not coincide with that of Greenwich.

In a series of important articles on the forms of cirrus-clouds, the last of which appeared in the *Meteorologische Zeitschrift* for October (vol. xxii., No. 10), Prof. Oslhoff, of Cologne, sums up his observations, extending over twenty years, as follows:—The ordinary origin of different cirrus forms are air currents of various kinds, which either cause existing cloud material to rend itself, or

carry water vapour which is condensed by penetrating colder air strata, and are immediately converted into ice-needles. These forms are also found under the more moderate clouds of the lower strata of the atmosphere, but in coarser form. Cirrus clouds gradually change their form in a period which coincides with that of the sun-spots, and consequently are caused by solar radiation. No kind of cirrus-cloud can be used with certainty as a weather sign. The influence of the sun at the time of sun-spot maximum is unmistakable in the case of clouds of moderate elevation.

In the *Journal and Proceedings of the Royal Society of New South Wales* for 1902 (vol. xxxvi. p. 42) Mr. H. I. Jensen contributed a paper on the possible relation between sun-spot minima and volcanic eruptions. This paper contained the results of an examination of the statistics, from 1780, relating to seismic disturbances and volcanic eruptions, and the conclusion at which the author arrived was that the frequency of both these phenomena varied inversely with the sun-spot curve, or, in other words, the fewer the sun-spots the greater the number of earthquakes and volcanic eruptions. In the volume of the same journal for the year 1904 (vol. xxxviii. p. 40) the author pursues the inquiry further, and, as he says, "I have succeeded in collecting numerous facts which throw further light on the question and strengthen my former conclusions." Later on in the paper the author refers to the letter published in the *Times* (May 19, 1902) by Sir Norman Lockyer, who stated that earthquakes and eruptions were most frequent at sun-spot minima and maxima. In this connection the author writes:—"My view was, and is, that these phenomena are at a maximum when sun-spots are at a minimum, although from my later researches it seems that at sun-spot maxima there sometimes is a violent and spasmodic outburst of volcanic violence."

Part ii. of this second communication deals with the connection between sun-spot and meteorological phenomena. The author here collects and summarises the conclusions of many workers, and adds a list of recent papers dealing with sun-spots, prominences, corona, earth-magnetism, auroræ, and meteorological data discussed in relation to solar changes. The communication concludes with a table of seismic and volcanic disturbances which occurred between April 1, 1902, and December 31, 1903.

In March last Dr. W. N. Shaw read a valuable paper before the Royal Statistical Society entitled "Seasons in the British Isles from 1878," which appeared in vol. lxviii., part ii., of the journal of that society. We have now received a reprint of that paper, and as it contains no less than 97 pages, including a discussion which occupies 6 pages, the reader may conclude that the subject has received very minute consideration. As director of the Meteorological Office, Dr. Shaw has at his command the most complete and homogeneous series of meteorological observations of these islands that exists, and in the present compilation he has so arranged the data that they are in a form at once suitable to anyone who may wish to study the relations of various phenomena with British weather. Like most other regions of the world, the British Isles are subject to wet years, dry years, cold years, and warm years, so that successive seasons differ very considerably from one another. Some of the meteorological statistics are therefore arranged to show at a glance the various characteristics of any year or season of the year. The contents of the reprint before us are not, however, restricted to the statistics of the meteorological data alone. We find that statistics relating to fog days in London, gales on the east coast, sea casualties, storm warnings, first flowering of forest trees, shrubs, herbs, beginning of corn harvest, yield of crops, deaths from various diseases, &c., are carefully correlated with the meteorological data according to each of the four seasons of the year. In the course of this compilation it was found that the relation between the autumn rainfall and the yield of wheat was very close. In fact, dealing with data from the year 1885, the yield was found to be above the average when the previous autumn rainfall was below the average and *vice versâ* (1889 and 1903 excepted). Space does not permit us to deal with this important contribution at greater length, so we must refer those of our readers who are particularly interested in such statistics to the reprint itself.

In a pamphlet entitled "Ueber die wahrscheinlichkeit von periodischen und unperiodischen Schwankungen in dem atlantischen Strome und ihren Beziehungen zu meteorologischen und biologischen Phaenomenen," written by Otto Petterson, we have an interesting and valuable discussion on the correlation of hydrographic, biological, and meteorological data. This pamphlet is an extract from "Gesamtbericht, 1902–4," vol. iii., of the report and *procès-verbaux* of the international committee on the exploration of the sea (August, 1905), with the addition of an interesting introduction in which is briefly and clearly summed up the general hydrographic condition of those particular parts of the ocean referred to in the paper. In dealing with the annual variations it is first pointed out that there exists a temperature change of deep water (250 metres) at Motowskijfjord which reaches a maximum value in about November; this change is brought about by the Atlantic water. Reference is next made to the annual variations of the depths of the sea near the coasts of Holland and Sweden, and here the maximum is again in late autumn, namely, from October to December. It is shown that we are here in presence of a new phenomenon, namely, an annual pulsation of the sea, of which the whole ocean, from the tropics to the polar seas, takes part.

Our attention is then directed to the changes which take place from year to year, and it is shown how similar are the variations of the temperature of the sea on the Norwegian coast and the air temperature in the centre of Sweden. It is pointed out that the annual variation sometimes suffers perturbations, and is at times retarded or accelerated by a month or two; this is accompanied by important climatic and biological changes. The general impression gained is that the maxima and minima of water and air temperatures in the winter months are repeated in alternate years which indicate a two-year period in the hydrographic perturbations. The author then connects up these regular and irregular changes with the fisheries, and concludes that there exists a close connection between hydrographic, meteorological, and biological phenomena which should in future be taken into account.

ANTARCTIC EARTHQUAKES.

THE *Discovery* carried with her to the Antarctic regions one instrument which kept her, to a slight extent, in touch with the outer world. During the long intervals between the visits of the relief ship there was no word of sport or of the strife of party politics which fill so large a space in the daily papers, but from time to time the Milne seismograph told that somewhere there had been a great earthquake, and in some cases could even say approximately where it had taken place. Now, the records are serving another purpose, and the first instalment of their discussion has appeared as a "Preliminary Note on Observations made with a Horizontal Pendulum in the Antarctic Regions," read before the Royal Society by Prof. J. Milne, F.R.S.

In all, some 3000 feet of films, obtained by Mr. Louis Bernacchi, were brought back by the *Discovery*, and, as might be expected, their examination is still incomplete, in spite of the assistance which Prof. Milne acknowledges; yet one result stands out from the wealth of hints and suggestions which crowds the paper, in the discovery of a new submarine earthquake region lying to the south-west of New Zealand, from which came 73 out of the 136 distinct earthquakes recorded. This, however, does not end the matter, for it is found that not a few of these earthquakes were also recorded by the Milne pendulums in England, that is, near the antipodes of the origin, but not by similar instruments at a less distance. The explanation offered may best be illustrated by a simple experiment, which anyone can perform; take a circular tub containing water, dip your hand into the middle and raise it sharply, thus setting up a group of waves which travel outwards from the centre, becoming less and less conspicuous as the circles widen, until they may cease to be visible; presently, however, the reflected waves, con-

verging on the centre, will become visible, and, as the circles narrow, the waves get higher and more conspicuous until the centre is reached again. So the earthquake waves may become too small to be registered as they spread out from the origin, but again affect a seismograph as they converge towards its antipodes. Doubtless it is not only the earthquakes of the newly discovered region in which this takes place, but the present distribution of teleseismographs is not such as will allow of its being established in the case of other earthquake regions.

Apart from these results, which seem well established, there are many suggestions contained in the paper, two at least being important ones. The first of these concerns a peculiarity in the distribution of the stations at which earthquakes are recorded; for instance, those originating in the region to the south-west of New Zealand will be recorded along a band, of about 20° in width, starting in a north-westerly direction, but not at stations lying, nearer the origin, on one side or other of this band. So, too, earthquakes originating off the west coast of South America have been recorded in western Europe and, near their antipodes, in Siberia, but not at stations which we should expect them to affect were they propagated with equal intensity in an opposite direction.

The other suggestion, which may prove of great importance, concerns the diurnal east and west movement of the horizontal pendulum. This only affects pendula which point north and south and swing east and west; it is only noticeable on days when the sun shines, and has been attributed to the action of the sun's rays in heating or drying up the ground on either side of the recording station. These explanations have not proved satisfactory, and it is now suggested that the movement may be due to some other indirect effect of the sun, probably of an electrical nature. The Milne pendulum, with its silk fibre suspension and agate cup bearing, is practically insulated, and Prof. Milne finds that one of his pendula, after being electrically connected to earth, and therefore preserved at the same potential as the outer case and walls of the observatory, does not show the extensive movements it did prior to being earthed. This line of research is being carried forward with the cooperation of Dr. C. G. Knott, of Edinburgh, and we look forward to seeing some interesting results in due course.

We have indicated the most interesting of the results which have come from the seismographic records of the Antarctic Expedition; want of space forbids us to detail the many other suggestions and possibilities set forth by Prof. Milne, but what has been noticed is enough to show the good use that has been made of the record which, taken by itself, has little value, and only becomes important when correlated with those of the thirty-eight other stations where the Milne type of instrument is now installed.

TECHNICAL EDUCATION FOR FISHERMEN.

ABOUT six years ago the Lancashire Sea Fisheries Committee instituted practical classes for the instruction of local fishermen in the natural history of the common marine edible animals. "Technical education" in the strict sense of the word was not the object aimed at. For some time previously the committee had experienced considerable difficulty in enforcing the restrictions on methods of fishing contained in their by-laws on account of the determined opposition of the fishermen, and the object of the classes was rather to remove this opposition by showing the *rationale* of the by-laws, and to create a common ground on which both officers and fishermen could meet. The committee had no funds which they could apply to this work, and the classes were only made possible by the cooperation of the Technical Instruction Committee of the Lancashire County Council, which made an annual grant of 250*l*. to be spent for this purpose.

Practically all this money is expended in providing "fisheries exhibitions" of the value of 5*l*. each. One or more of these is allotted to each fishing centre in the administrative county of Lancaster, and the men selected to attend are chosen in various ways. In some cases they are selected by the fishermen's associations, and in other cases they are chosen by the officers of the committee. The grant of 5*l*. is intended to recompense the fisherman exhibitioner for the loss of his labour during the time he attends the class, and to provide for his expenses during this period.

The first two experimental classes were held at the (then) University College of Liverpool, but subsequently the work was transferred to the Lancashire Fishery Station at Piel, in the Barrow Channel, where tanks and other apparatus for the study of living organisms are provided by the fisheries committee, and where living material can easily be landed by the committee's vessels. The men are brought to Piel and taken away again by the patrol steamer, and lodge in the neighbourhood of the station. Each class consists of fifteen men, the maximum number which can be taught at one time with advantage. Twenty two-hour lessons are given during each course.

The course of instruction was drawn up by Prof. Herdman and Mr. Johnstone, and great care was taken to arrange a logical sequence of lessons. The structure of a typical fish is the first lesson, and this is followed by an account of the life-history of a typical mollusc such as the mussel. A short demonstration of the main chemical and physical processes involved in the respiration of marine animals is then given, and the manner of feeding of two such divergent types as the fish and mussel is then considered, a discussion which naturally leads up to three or more lessons on the nature and occurrence of plankton and on the economic importance of the latter. The remaining lessons deal with the life-histories of other economic marine animals, the cockle and oyster among Mollusca, and the shrimp and crab among the Crustacea. The life-histories of various fishes, such as the flat-fish and skate, are also considered, and the development of the flounder is studied from the process of fertilisation up to the time when the embryo issues from the egg. Although lantern and other demonstrations are given, the instruction is in the main practical in character, each man being provided with a good microscope and a set of dissecting tools.

On the whole the results of the classes have been very satisfactory; the main object, that of bringing about a better understanding between the fishermen and the committee, has been attained, and though there is still considerable opposition on the part of the fishermen towards the by-laws, yet the relations are much less embittered than was formerly the case. Another result of considerable importance has been attained in that the shell-fish transplantation operations carried on at Morecambe (an account of which was given recently in NATURE, August 31, p. 430) have been traced directly to the stimulus afforded by the classes. This work was originated by the Morecambe fishermen themselves, and it was in this district that the fishery classes were most appreciated and supported.

J. J.

LIFE-HISTORY OF THE EMPEROR PENGUIN.[1]

THE emperor is the largest of all the penguins, and is limited strictly to the ice-covered regions of the Antarctic. The interest of its life-history lies chiefly in the fact that its breeding ground was first discovered during the recent expedition made by the *Discovery* into the Antarctic. Its young and its eggs were brought home for the first time when the *Discovery* returned to England in September, 1904.

In reviewing the life of this bird, the difficulties of investigating its breeding habits were explained as the result of certain peculiarities; for example, that of laying the eggs in the middle of the winter darkness; each hen laying a single large egg, which it incubates as it stands in an upright position on sea-ice, keeping the egg from contact with the actual ice by holding it on the *dorsum* of the foot, and allowing a heavily feathered fold of skin to fall over it from the abdomen, thus completely obscuring it from view, and keeping it closely appressed to the abdomen, warm enough to hatch out, probably in some seven weeks. In the coldest month of the whole year,

[1] Abstract of a paper delivered before the Royal Institution by Edward A. Wilson.

viz. August, the chicken is hatched out, and becomes the unwilling recipient of so much attention from its parents, and from such other adults as have no young of their own to attend to, that upwards of 77 per cent. die, and may be picked up frozen on the sea-ice, within the first month or two of their existence. This high death-rate is in a large measure the result of the quarrels of adult birds for possession of a chicken, all having an overpowering desire to brood over something. In many cases the desire leads to brooding over dead chicks until they are actually rotten.

Much was said of the trials that must be endured by the naturalist who wishes to see this bird in its breeding haunts. He must be ready to encounter the lowest temperatures hitherto recorded, under canvas, sleeping three in a bag for what warmth can be procured at 40°, 50°, and 60° below zero Fahrenheit, and for a fortnight or three weeks at a stretch. Much, also, was said of the various sledge expeditions undertaken, after its first discovery by Engineer-Lieutenant Skelton, R.N., for the purpose of fully investigating the emperor penguin rookery at Cape Crozier; of the discovery of the first egg on the sea-ice by Lance-Corporal Blissett, R.M.L.I., and of the exceptional circumstances which, in the following year, enabled the lecturer to bring back to the ship a series of some fourteen eggs and several dozen of the young.

Examples were shown at the close of the lecture, which was further illustrated by a series of lantern slides, made from photographs taken mainly by Mr. Skelton and from drawings by the lecturer of the various stages in growth of the emperor penguin, from infancy to old age.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN view of the approaching contest for the representation of the University of London in Parliament, Sir Michael Foster, K.C.B., and Sir Philip Magnus have placed their opinions before members of Convocation of the University.

SIR WILLIAM ANSON has accepted the position of president of the Association of Technical Institutions for next year in succession to Sir Philip Magnus. The annual meeting of the association will be held at the Fishmongers' Hall on January 26 and 27.

THE annual conversazione of the Royal College of Science and Royal School of Mines was held on December 20. All the departments of the college and school were open, and many interesting exhibits were shown in chemistry, physics, mechanics, metallurgy, mining, geology, botany, and zoology, including applied science. The metallurgy section comprised a working exhibition of Japanese smelting methods shown for the first time in Europe. Japanese casting was made during the evening. The programme also included a lecture by Prof. S. H. Cox on "Incidents of a Mining Career."

THE late Mr. John Feeney, by his will dated June 22, 1903, bequeathed sums amounting to 89,000*l.* towards various institutions and objects connected with Birmingham and district. These include 20,000*l.* to the University of Birmingham. This bequest is for the purpose of maintaining a professor, with suitable equipment, lecturing on some one or more scientific subjects directly connected with some one or more of the trades and industries carried on in or near Birmingham. All the bequests are given free of legacy duty, but payment cannot be claimed until the expiration of five years.

THE Board of Education has published the reports, for the year ending March 31, 1905, of fourteen colleges which participated during the year in the annual grant, amounting to 54,000*l.*, made by Parliament for "university colleges in Great Britain," and from the three colleges in Wales which receive a grant of 4000*l.* each. The reports have been compiled, so far as has been found conveniently possible, under the same headings as those adopted in previous years. The distinguishing characteristic of the reports is the elaborate balance sheet with which each is provided showing exactly the revenue available in the case of each college and what precisely is done with it.

A BLUE BOOK (Cd. 2782) has been published giving the statistics of public education in England and Wales for the years 1903–5. The volume of 442 pages is divided into three sections, dealing respectively with elementary schools, State-aided secondary schools, and technical institutions, schools of art and day art classes, evening schools, and similar forms of education. A technical institution within the meaning of the regulations of the Board of Education is an institution giving an organised course of instruction in day classes, including advanced instruction, and provided with a staff and equipment adequate for the purpose. Provision must be made for at least a two years' systematic course in science, or in science and art, either alone or in conjunction with subjects of general, commercial, manual, or technological instruction; and subject to certain temporary provisions, no student may be admitted to the course unless he has passed through, at least, a three years' course of instruction in a school recognised under the regulations of the Board for secondary schools, or unless he is more than sixteen years of age and is qualified from his general education to profit by a course of advanced instruction. These institutions, in fact, afford instruction adapted for the preparation of young men for employment in connection with the trades, manufactures, and commerce of the country. They also provide higher courses of specialised instruction in science in relation to particular industries, likely to be required by students who have already had a good training in pure science. The number of these institutions receiving grants was nineteen in 1903–4. The number of students who attended at all during the year was 2143, and a grant of 5683*l.* was paid on 1056 of these who attended a full course of instruction. In the same year there were 5570 recognised evening schools with 696,882 students in attendance, on whose work a grant of 304,962*l.* was paid.

AT the annual headmasters' conference held at the College of Preceptors, London, on December 21, the subject of the inspection of schools was dealt with very fully, and numerous resolutions were adopted. Dr. Gow, of Westminster, moved a resolution, subsequently carried *nem. con.*, that the conference desires to emphasise the principle that inspection should take into due consideration the aims and circumstances of the school inspected, and regard intellectual methods and results as of greater weight than material equipment and appliances. Dr. Gow is reported by the Press to have said "there is a general opinion on the part of the public, which is shared by many teachers of science, that great expenditure is necessary for effective scientific teaching, and that schools are invited to compete with one another in mere expenditure. This competition is bad for the schools, for the teachers, and for the boys." It may be contended, he continued, that the better the teacher the more apparatus he wants, but Dr. Gow admitted that his own experience is the contrary of this. "No contention can be more absurd," he concluded by saying, "than that science teaching differs from any other because the science teacher does not teach by authority; it is, as a fact, conducted quite as much on authority as classical teaching, or divinity, or any other subject. The experiments are merely illustrations." The headmaster of Westminster has apparently been unfortunate in his experience of science teaching. Every man of science agrees with him that for the effective teaching of the broad principles of science the simplest apparatus, if of the right kind, is sufficient. This competition among schools to provide the most luxurious laboratories and lavishly stocked lecture-rooms, if it exists, is at least a very modern growth, and should, as Dr. Gow maintains, be discouraged. But at the same time a sensibly designed science workshop with simple fittings and an adequate supply of ordinary apparatus is an absolute necessity for every efficient school. It is difficult to understand what Dr. Gow means when he maintains that science teaching is as much based on authority as the teaching of classics or divinity. There is a confusion of thought here. Reasonable science teaching, with which Dr. Gow seems unfamiliar, insists that the pupil shall believe only because experimental results leave no other alternative, and not because a teacher or a text-book makes a statement. If in any school experiments are used only as illustrations the methods of science

are not followed, and the work is not what men of science desire to encourage. It is satisfactory to know that at least in a large number of our secondary schools the science periods are made the means of inculcating habits of careful observation, persistent verification, and truthful reasoning.

SOCIETIES AND ACADEMIES.

London.

Royal Society, November 23.—"On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*.—A Study in Relationship to the Causation of Malignant Disease." By Prof. B. **Moore,** Dr. Herbert E. **Roaf,** and E. **Whitley.** Communicated by Prof. W. A. Herdman, F.R.S.

The attention of the authors was attracted to the study of the effects of small variations in reaction upon the growth of cells from the biochemical point of view, as a result of the observation that in malignant disease no hydrochloric acid is in general secreted by the gastric glands, no matter where the malignant growth is situated, which pointed to an increased alkalinity of the plasma.

In the course of investigations upon the rate of growth of the cell, when microscopic examination was made of the cells in the fresh condition, the authors were struck by the marked irregularities in size and shape of the developing cells in alkaline media, illustrated by cells in fresh solution developing in sea-water, to which di-sodium phosphate has been added, and also by marked tendencies to nuclear proliferation.

This led secondarily to a cytological investigation of the cells when fixed and stained to show nuclear division, as a result of which the authors have found the irregular forms of mitosis described in the paper. These atypical divisions, which have been produced by variations in the medium similar to those which occur in the blood in cases of malignant disease, closely resemble the pathological divisions seen in the growths of malignant disease.

The results of the experiments and their relationship to the processes in malignant growths may be summarised as follows:—

(1) In nearly all cases of malignant disease the secretion of hydrochloric acid by the gastric glands is stopped or greatly reduced, and this effect is not due to local conditions in the stomach, since it occurs wherever the growth is situated, but is due to a change in the distribution of salts in the plasma whereby the alkalinity is increased or the concentration in hydrogen ions diminished.

(2) Addition of *small* amounts of alkalies or alkaline salts, such as di-sodium phosphate, to the medium in which cells are growing and dividing causes at first an increase in rate of growth and division, but as the amount is increased there appears a marked tendency to irregularity in size and shape of the resulting cells. Nuclear division becomes in advance of cytoplasmic division, so that the cells become multi-nucleated. As the alkali is further increased, both cell division and nuclear division are stopped.

(3) Accompanying the increased stimulus to nuclear division given by the dilute alkali, there are seen many of the atypical forms of mitosis described in malignant growths. The variations from the normal illustrated in the drawings are:—(1) multiple nuclei in the same cell in active division; (2) multipolar mitosis, occurring both in the single cell stage, and later in the development of the organism; (3) asymmetrical mitosis, leading to unequal distribution of chromosomes to the two daughter cells; (4) reduction in length of the chromosomes as the strength of alkali is increased until the chromosomes appear as rounded dots, and accompanying the reduction in length there is also a reduction in number to about one-half the normal; (5) in certain cases the chromatin becomes arranged in circles, each of which shows a number of thickenings. The circles are arranged in groups in the cell, and appear to represent a stage in the anaphase, the groups being placed at about the usual distance apart of the centrosomes, and traces of the achromatic fibres being occasionally visible.

"On certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics.—A Contribution to the Chemistry of Anæsthesia. (Second Communication.)" By Prof. B. **Moore** and Dr. Herbert E. **Roaf.** Communicated by Prof. C. S. Sherrington, F.R.S.

The experiments recorded in the present communication support the conclusion drawn in a previous paper by the authors that anæsthetics form unstable compounds or aggregates with the proteids of the tissue cells, and that anæsthesia is due to a paralysis of the chemical activities of the protoplasm as a result of the formation of such aggregations.

The comparative experiments with ethereal extracts demonstrate that the action is upon the cell proteids and not upon the lipöids.

The compounds or aggregations so formed are unstable, and remained formed only so long as the pressure of the anæsthetic in the blood is maintained.

The results of the experiments may be summarised as follows:—

(1) The solubility of all anæsthetics experimented with is higher in serum than in water.

(2) At a certain concentration, definite for each anæsthetic, there occur opalescence and commencing precipitation of proteid.

(3) At equal concentration of chloroform in water or saline on the one hand, and serum, hæmoglobin, or the tissues (brain, heart, muscle, and liver) on the other, the vapour-pressure is always higher in the former than in the latter.

(4) The curve connecting vapour-pressure and concentration is, in the case of water and saline, a straight line; while in the case of serum, hæmoglobin, and the tissue proteids it is a curve showing association, especially at the higher concentrations.

(5) Comparative determinations of vapour-pressure and concentration, in serum and brain tissue and in ethereal extracts of these equal in concentration of lipöid, show that the proteid of the tissue combines with the anæsthetic.

(6) Determinations of the effects of addition of chloroform upon the lowering of freezing point confirm the results obtained by the vapour-pressure and solubility determinations.

(7) Determinations of the changes in electrical conductivity caused by addition of chloroform indicate that accompanying the combination of the anæsthetic with the proteid there takes place a splitting off of electrolytes.

(8) When the lipöids, extracted from serum or tissues by ether, are made up into an emulsion with normal saline, many of the lipöids take the form of bi-concave discs.

(9) The lipöid emulsions are very permanent, but separate on the addition of anæsthetics or neutral salts, in similar fashion to colloidal solutions.

"A Note on the Effect of Acid, Alkali, and certain Indicators in Arresting or otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*." By E. **Whitley.** Communicated by Prof. W. A. Herdman, F.R.S.

(1) The amount of variation from the normal concentration of hydrogen and hydroxyl ions in sea-water which the eggs of Pleuronectes will tolerate is very small.

(2) A disturbance of the equilibrium towards the acid side is much more fatal than the opposite.

(3) A progressive development of resistance to an unfavourable action of the environment takes place in proportion to the age of the eggs.

(4) Phenolphthalein is deadly to the eggs of *Echinus esculentus*, but harmless to those of Pleuronectes, while dimethyl quickly kills the latter, and appears, if anything, to have a favourable influence upon the development of the former.

Anthropological Institute, December 5.—Prof. W. Gowland, president, in the chair. A Dyak witch doctor's medicine chest: R. **Shelford.** The chest is cylindrical in shape and about a foot high, and contains various charms, including water-worn pebbles, a crystal, used for a kind of crystal gazing, and a few simples which have actual curative properties.—Ruins in Rhodesia: D. Randall

MacIver. Mr. MacIver visited sites at Inyanga, Niekerk, N'Natali, Umtali, Dhlo-Dhlo, Kami, and Zimbabwe, views of all of which were shown. At Inyanga there are countless "pit dwellings," consisting of a pit and passage and hut platforms. The elucidation of the mystery of their use is assisted by a study of the Niekerk ruins, which are the most remarkable in the country. The area of these ruins is not less than fifty square miles, and within this area it is almost impossible to walk more than ten yards without coming upon a wall. The general principle appears to be that each hill constitutes a separate unit complete with its own buildings and divided at the bottom from its neighbour by a boundary wall, which is the first of a series of concentric lines. These lines cannot have been for purposes of irrigation, but must have been entrenchments. They always cease at the crown of the hill, which is covered by a series of buildings, and it is this fact which shows the bearing of these walls in the problem of the pit dwellings. The buildings in the hill are of two types, one divided by successive stages from the pit dwelling and the other the pit dwelling itself. The forts at Niekerk are also generally of similar or derived form to those at Inyanga. Similarly, the more advanced type of buildings found at Umtali or elsewhere are all derivatives of the pit dwelling, and Great Zimbabwe itself falls into line, and was simply a royal kraal. In the whole country there seems to be a regular progression with regard to these buildings, the northern region being the most fortified, and the defensive scheme becoming less rigorous towards the south. As to the buildings of these forts and dwellings, all the implements found are of the type used by the natives of the present day, and as at Niekerk there is no evidence of modern squatting it seems fair to presume that similar implements found elsewhere are also not the results of squatting, but were left by the original builders. As to the date, Mr. MacIver cut sections in the ruins he visited, and at Dhlo-Dhlo he made a most significant and conclusive discovery. A trench was cut below the intact cement floor of a hut, and amongst other objects Mr. MacIver discovered fragments of Nankin china. Consequently, no stone was laid at Dhlo-Dhlo before the time when Nankin china was manufactured and imported from the East; experts fix this date as the sixteenth century A.D. This find conclusively fixes the date, for Dhlo-Dhlo and all the other remains exhibit similar characteristics of building, and it may be taken as proved that the ruins of Rhodesia are mediæval or post-mediæval, that they cannot be possibly placed earlier than the eleventh century (probably the very oldest building was not erected before the fourteenth century), and that they were built by a native African race not differing to any great degree from the modern natives.

Entomological Society, December 6.—Mr. F. Merrifield, president, in the chair. *Exhibitions.*—A series of varieties of the Mediterranean *Carabus morbillosus*, showing all intergradations from the ordinary *morbillosus*, and presenting a striking case of geographical variability: Dr. K. **Jordan.** Specimens of *Ptinus pusillus*, Stwem., recently discovered in a corn factor's shop at Edmonton: H. St. J. **Donisthorpe.**—A hermaphrodite of the Proctotrupidæ, a sand-wasp without wings captured by Mr. Poole, and the ♂ *Apion semivittatum*, Gyll., taken many years ago by Mr. Walton near the Tivoli Gardens, Margate, together with a ♀ specimen of the same species discovered while sweeping long grass near the Chequers Inn, Deal, on September 26, 1904: A. J. **Chitty.** A ♂ and ♀ example of the Dipteron *Helophilus transfugus*, L., taken from thistle-heads in the fen marshes at Edmonton last July, and a specimen of *Stenopteryx hirundinis*, a parasite on swallows and martins found on Box Hill, Surrey, in August: F. B. **Jennings.**—Specimens of *Odontopera bidentata* ab. *nigra*, the melanic form of which is rapidly increasing in the Wakefield district of south Yorkshire: G. T. **Porritt.**—Specimens of South African Pierine butterflies taken in the dry season this year, further illustrating the diverse forms, and with them, for comparison, specimens taken during the rains: Dr. F. A. **Dixey.** A ♂ and ♀ specimen of *Ornithoptera chimaera*, Rothschild, and some remarkable species of Delias collected recently by Mr. A. S. Meek in the mountain region of British New Guinea: O. E. **Janson.**—Specimen of a Buprestid beetle, *Cyria imperialis*, Don., having, in addition to the normal fore-leg on the left side, two supplementary fore-legs originating from separate coxæ: Commander J. J. Walker, on behalf of Mr. A. M. **Lea.**—♂ and ♀ examples of *Tetropium crawshayi*, Sharp, bred by the Rev. G. A. Crawshay from eggs deposited in July last in the bark of larches at Leighton Buzzard: G. C. **Champion.**—Unique specimen of *Depressaria emeritella*, Stn., from an unknown locality, on which the species was added to the British list many years ago, and a specimen of *Cerostoma asperella*, L., discovered by Mrs. Hutchinson near Leominster on September 21, 1881, and only taken, as regards Britain, in Dorset (formerly), and Herefordshire very rarely: E. R. **Bankes.**—Series of *Tryphaena comes* bred through three generations, and brought together to test the relative proportions of melanic to non-melanic forms and the possible range of variations to be obtained from a single pair of parents: A. **Bacot.** The exhibitor announced that all the results of the second and third generations seemed to be capable of "Mendelian" explanation. (1) Larvæ of *Collyris emarginatus*, Dej., from Borneo, observed with mouth-parts qualified to excavate burrows in wood. (2) Larvæ and pupæ of Mormolyce, together with a specimen of a fungus of Polyporus split open to show the lenticular chamber excavated by the larva, to which access was obtained by so small an orifice that it was surprising that the emerged beetle could squeeze through: R. **Shelford.**—*Papers.*—Some observations by Mr. A. H. Hamm, of the Hope department, Oxford University Museum, tending to confirm the opinion that *Pieris rapae* chooses for prolonged rest a surface on which it will be concealed: E. B. **Poulton.**—On the emergence of *Myrmeleon formicarius*: W. J. **Lucas.** Descriptions of new species of African Halticinæ and Galerucinæ: M. **Jacoby.**—On the ichneumonidous group *Tryphonides schizodonti*, Holmgr., with descriptions of new species: C. **Morley.**

Linnean Society, December 7.—Prof. W. A. Herdman, F.R.S., president, in the chair.—On the ætiology of leprosy: Dr. J. **Hutchinson**, F.R.S. The author adduced much evidence from all parts of the world in support of the fish hypothesis of the cause of leprosy, more especially from South Africa, China, and Norway. In places where the disease is scattered and infrequent there might, he admitted, be some difficulty in tracing the association of cause and effect; but if regard be taken of those only in which excessive prevalence occurs, all hesitancy would disappear. He challenged anyone, not yet convinced, to name any place in the whole world in which the leprosy prevalence exceeded 50 per 10,000 which was not either a fishing-station or notorious for the consumption of bad fish. As instances of places where this enormous prevalence has been recorded, the following were mentioned:—Minicoy (Maldives), Kalagoan (Bengal coast), Fiji, and the Sandwich Islands. By way of affording a standard of comparison, it was added that the prevalence in Ceylon was only 2 per 10,000, and in India as a whole less than 6.

Faraday Society, December 12.—Mr. James Swinburne, vice-president, in the chair. The physics of ore flotation: J. **Swinburne** and Dr. G. **Rudorf.** The flotation of ores to separate them from gangue is carried out by treating them with dilute acid, or acid sodium sulphate, at a temperature short of boiling water. Little bells of CO_2 attach themselves to the ore particles, but not to the gangue, and the ore particles are floated to the surface, where they are skimmed off. The questions are why the sulphides are selected, and why the temperature matters. The authors hold that it is a question of two opposing forces—adhesion between the solids and the liquid which varies with different solids and liquids, and surface tension of the liquid.—The concentration of metalliferous sulphides by flotation: Prof. A. K. **Huntington.** The paper also embodies the author's contribution to the discussion on the previous paper. Experiments are described which prove that the gas causing flotation is CO_2 derived from native carbonates of iron and manganese present in the ore, and not from calcite or from carbonates produced on the surface of the sulphides by weathering. Carbonates which are decomposed by dilute sulphuric acid in the cold do not

give rise to the formation of a scum. Experiments are also described showing that the gas escaping during flotation carries an electrical charge, leaving an opposite charge on the solution. The assumption of Messrs. Swinburne and Rudorf of the presence of an air-film on the surface of the sulphide particles is criticised, and it is shown that the particles are floated perfectly after precautions have been taken to remove any adherent film of gas by exhaustion with acid, washing with alcohol, treatment with air-free distilled water, and exhaustion with the pump.—The ions of pure water: Prof. J. **Walker.** In the discussion on Dr. Lowry's paper on an application to electrolytes of the hydrate theory of solution, Mr. Bousfield directed attention to an apparent discrepancy between the temperature coefficient of the mobility of hydrogen and hydroxide ions on the one hand, and the temperature coefficient of the conductivity of water on the other. The author points out that when the data obtained by Kohlrausch for pure water are employed, and when allowance is made for the temperature coefficient of ionisation, the discrepancy vanishes.

Geological Society, December 12.—Dr. J. E. Marr, F.R.S., president, in the chair.—The physical history of the great Pleistocene lake of Portugal: Prof. E. **Hull.** There is evidence that the general level of the lake-bed was once nearly that of the outer sea, and that the sea-waters gained occasional access to the lake during the earlier stage of its formation. The lake was eventually drained by the channel cut by the Tagus at the harbour of Lisbon, upon the elevation of the land to about its present level.—The geological structure of the Sgùrr of Eigg: Dr. A. **Harker.** The conclusions arrived at bring the rock of the Sgùrr of Eigg into relation with the other British Tertiary pitchstones, which are all intrusive.

MANCHESTER.

Literary and Philosophical Society, November 28.—Sir W. H. Bailey, president, in the chair.—Experiments on the variation of the electrical resistance of osmium with the temperature: H. **Morris-Airey.** The range over which the experiments were conducted extended from the temperature of liquid air up to dull red heat. The results show that the behaviour of osmium, like that of the ordinary metals, can be represented by a parabolic expression.

DUBLIN.

Royal Dublin Society, November 21.—Prof. W. F. Barrett, F.R.S., in the chair.—Energy of secondary radiation: Prof. J. A. **McClelland.** This paper is a continuation of previous papers in which the author studied the secondary radiation of β particles that is emitted by substances when acted upon by the β rays of radium. The relative intensity of the secondary radiation from a large number of elements for the same incident radiation has been previously measured, the results showing that the secondary radiation is always greater the greater the atomic weight. In the present paper the total energy of the secondary radiation from a lead plate is compared with the energy of the primary radiation that produces it, the plate being thick enough to prevent the transmission of any radiation; the ratio is found to be 0·62 for lead, and corresponding numbers are given for other elements, the numbers, of course, diminishing with decreasing atomic weight, the number for carbon being 0·19. From the known value of this ratio we can calculate theoretically what percentage of the energy absorbed by *any element of the plate* is set free again as secondary radiation; the percentage is as high as 94 for lead and 95 for uranium, with smaller values for lower atomic weights, the percentage for carbon being 53. The importance of this large transformation of the energy of the primary radiation into secondary radiation is shown by some examples. The relation between the coefficient of absorption of the β rays and the value it would have if there were no secondary radiation is calculated; for lead one coefficient is about four times the other. Again, when we determine the coefficient of absorption of a radiation by measuring the intensity after passing through successive layers of a substance, we should, on account of secondary effects, get values of the coefficient diminishing with increased thickness traversed, even if the radiation were perfectly homogeneous. For this reason the β rays from radium are not so heterogeneous as they appear to be from observations on absorption. The paper shows how to determine the true coefficient from such observations.—An improved form of entoptoscope for the detection and delineation of cataract, &c.: W. F. **Barrett,** F.R.S. The author exhibited this instrument, and fully described it with the aid of diagrams and lantern slides.

Royal Irish Academy, November 30.—Prof. R. Atkinson, president, in the chair.—Second report on Irish cave explorations: Dr. R. F. **Scharff,** chairman of the committee. Dr. Scharff gave a general survey of the investigation, and mentioned that the report embodied the results of the work carried on in the caves of co. Clare during the years 1903–4 under the direction of Mr. R. J. Ussher. The latter subsequently showed a series of lantern slides giving a narrative of the events. Prof. Cole described the geological features. The caves originated by the solvent action of water on the Carboniferous limestone, and may possibly be pre-Glacial. Mr. Westropp read the portion of the report dealing with the tools and ornaments found, which included chert scrapers, various bone implements, bronze pins, and a beautifully worked bronze buckle, as well as an ancient gold bracelet. Prof. A. F. Dixon dealt with the human remains, while Mr. Newton described the very numerous bird bones, which included those of the crane, now only an extremely rare irregular visitor to the British Isles. The mammalian and other vertebrate and invertebrate animal remains had been determined by Dr. Scharff, who exhibited specimens of the bones and teeth of Irish elk, reindeer, Arctic lemming, Arctic fox, bear, wolf, and Caffer cat, and those of domestic animals, &c., making remarks on their horizontal, vertical, &c., distribution in the caves.—On the former occurrence of the African wild cat (*Felis ocreata*, Gmel.) in Ireland: Dr. R. F. **Scharff.** Remains of the wild cat are abundant in the upper stratum of the Clare caves. Careful measurements show that this cat was not the wild cat of Europe (*Felis catus*), but the African cat (*F. ocreata* = *F. maniculata*), and that the English cave remains of cat are also mostly referable to the latter species.

EDINBURGH.

Royal Society, November 20.—Lord McLaren, vice-president, in the chair.—Some further results obtained with the spectroheliometer: Dr. J. **Halm.** This was a sequel to a previous communication already published in which the main object was to find how Carrington's law of solar rotation varied with the sun-spot cycle. The relative shift of certain solar spectrum lines taken from opposite limbs of the sun was determined by comparing their positions with the positions of neighbouring telluric lines. If, however, instead of the *difference* of the positions of a chosen solar line the *mean* be taken, the true position of the solar line referred to the neighbouring telluric line is obtained as it would be were the sun not subject to rotation. Now, according to Doppler's principle, the relative position of the solar and telluric lines so determined should be affected by (1) the annual motion of the earth as it recedes from and approaches to the sun; (2) the diurnal motion of the earth on its axis; and (3) the swing of the earth about the centre of gravity of the earth and moon during one complete lunation. The amounts of the displacements of the lines in the solar spectrum due to these three motions may be calculated. The monthly motion is too small to be detected with certainty, being of the same order as the errors of observation. The instrument was capable of detecting the others. By calculating the diurnal effect and subtracting it from the observed positions, Dr. Halm obtained a distinct annual periodicity in the measured positions of the chosen line, and the observed variation agreed within the errors of observation with the calculated effect. Similarly, subtraction of the calculated annual effect left the diurnal effect clearly marked

and agreeing also remarkably well with the calculated value. In the observations, however, which had extended over the last four years, there existed undoubted evidence of a shift which could not be explained in terms of any known motions. It would be interesting to see how this shift continued as the sun-spot cycle passed through its approaching maximum. The only suggestion which the author had to offer in explanation was the possible effect of a changing pressure in the sun in the neighbourhood of the material giving the line.—Observations on the normal temperature of the monkey and its diurnal variation, and on the effect of changes in the daily routine on this variation: Drs. Sutherland **Simpson** and J. J. **Galbraith.** The diurnal temperature variation in the monkey had considerable range, being about twice that of man in normal health. The temperature reached its maximum during the day and its minimum at night. When by artificial illumination and darkening of the room day and night were interchanged, and when at the same time the meals were altered appropriately, the temperature variation was found to change also, the maximum always coming during the time of activity. Starvation for three days quite did away with the rhythmic character of the variation.—Notes on the effect of electric oscillations (co-directional and transverse) on the magnetic properties of iron: J. **Russell.** The oscillations were obtained from an induction coil, and their general effect was greatly to increase the induction in moderate fields, and also to increase the hysteresis during a complete cycle. When the cycles were compared between the same limits of induction, the effect of the electric oscillations was to diminish the hysteresis.—Some electrical measurements on metals: Dr. C. E. **Fawsitt.** The aim of the experiments was to measure the electromotive position of two specimens of the same metal, one of which had been rapidly cooled and hardened and the other slowly cooled and annealed. The metals used were silver, gold, and platinum, and in all cases the hardened amorphous form was found to be electropositive to the annealed crystalline form when placed in dilute acid, the potential difference being about 0·013 volt.

New South Wales.

Linnean Society, September 27.—Mr. T. Steel, president, in the chair.—Notes from the Botanic Gardens, Sydney, No. 11: J. H. **Maiden** and E. **Betche.** In addition to several new species and varieties described, the following species are recorded as new for New South Wales:—*Capparis sarmentosa*, A. Cunn., from the Macpherson Range; *Casearia esculenta*, Roxb., from the same locality (the discovery of this species adds another order, Samydaceæ, to the flora of New South Wales); *Pultenaea mollis*, Lindl., from Gilgandra; *Erythroxylon australe*, F.v.M., from the Macpherson Range; *Strychnos psilosperma*, F.v.M., from the same locality; *Marsilea angustifolia*, R.Br., from Gilgunnia.—Notes on the native flora of New South Wales, part iv., the occurrence of *Casuarina stricta*, Ait., on the Narrabeen shales: R. H. **Cambage.** *Casuarina stricta* is one of the sheoaks found chiefly in the southern part of Australia, including Tasmania, and it is also common in the interior of New South Wales. The author recently found it growing on the Narrabeen shale formation at Newport. The shales dip southerly from Narrabeen, and pass under Port Jackson at a depth of nearly 1000 feet, but outcrop again at Otford and Stanwell Park, where *C. stricta* also reappears. The theory is advanced that in late or post-Tertiary time this species flourished on what is now regarded by geologists as the submerged continental shelf, but formerly was a continuation of the present land-surface, extending, perhaps, twenty miles easterly to the 100-fathom line. As the Narrabeen shales in the vicinity of Port Jackson also rise to the eastward, they would probably have formed the surface in places beyond the present shore-line, and it is suggested that *C. stricta* worked its way up from the south, partly along this old land-surface, but, owing to the subsidence, has all been destroyed with the exception of these isolated remnants at Newport, Otford, and Jervis Bay.—Census Muscorum Australiensium: a classified catalogue of the frondose mosses of Australia and Tasmania, collated from available publications and herbaria records: part ii.: Rev. W. W. **Watts** and T. **Whitelegge.** This second part of the census completes the mosses known as acrocarps. About 370 species are listed.

October 25.—Mr. T. Steel, president, in the chair.—The geology of the New Hebrides: D. **Mawson.** The following is a summary of the author's conclusions:—The chain of islands forming the New Hebrides group owes its existence primarily to the development during Miocene times of a fold-ridge apparently continuous with that passing around the north of New Guinea through Sumatra and on to the better known region of the Himalayas and southern Europe. In the New Hebrides the folding period was preceded by local shallow marine conditions and subdued volcanic activity. The folding force would appear to have been exerted from the direction of Fiji against the foreland of New Caledonian crystalline schists and gneisses; a single ridge probably resulted defining the western line of islands where extensive outcrops of Miocene strata are exposed—in Santo, Malekula, and possibly Efate.

CONTENTS.

THURSDAY, JANUARY 4, 1906.

BRITISH PROGRESS IN ENGINEERING.

National Engineering and Trade Lectures. Edited by Ben H. Morgan. Vol. i., *British Progress in Municipal Engineering.* By W. H. Maxwell. Pp. 182. Price 6s. net. Vol. ii., *British Progress in Pumps and Pumping Engines.* By P. R. Björling. Pp. xii+92. Price 6s. net. Vol. iii., *British Progress in Gas Works' Plant and Machinery.* By C. E. Brackenbury, A.M.I.C.E. Pp. xii+105. Price 6s. net (London: Archibald Constable and Co., Ltd., 1905.)

THESE lectures, as they are termed, are stated to be "a project to stimulate and expand British trade in colonial and foreign markets," and their "primary object is to show colonial and foreign buyers what progress Great Britain has made up to the present time in the manufacture of all classes of machinery and goods. Each lecture will emphasise novel points of design and utility, and up-to-date methods of manufacture; and these points will be graphically illustrated by reproductions of photographs and drawings." They are, accordingly, evidently designed to have an advertising and business character, instead of the educational and instructive objects which are generally associated with lectures. Engineering is assigned the first place in the British industries to be dealt with; and the three volumes enumerated above are the first ones published of the engineering series, eleven more of which are stated to be in preparation by experts in the different branches.

The first of these books, relating to municipal engineering, is definitely divided into three lectures, the first commencing with an introductory review of the progress of sanitary science and the work of large British municipalities, and then proceeding to deal with road engineering and maintenance; the second lecture treats of sewerage and main drainage, and sewage and refuse disposal; and the third is devoted to water supply.

Each lecture contains more printed matter than could possibly be read within the usual allotted period of one hour, not allowing for any references to illustrations; whilst, on the other hand, the space given to these lectures is far too limited to enable these very important subjects, with their wide range, to be dealt with except in a very cursory manner. The aim, however, it must be remembered, of these so-called lectures is not to explain the principles and describe the practice of various branches of engineering, but to indicate to persons in the colonies and abroad, by the aid of illustrations and brief descriptions in some cases, what are considered the best materials and the newest and most useful types of machines for carrying out works in these different branches, and the names of the manufacturers in Great Britain who supply them. For this purpose, in addition to the names of manufacturers and companies, appended in many cases to references to municipal works, plant, and materials, in the text, and to the illustrations, a list is supplied at the end of each lecture of the various makers of the plant, machinery, tools, and materials used in the municipal works which it describes, occupying altogether forty-eight pages. A short appendix, also, at the end of the book, gives a very useful list of the literature bearing on municipal engineering, to assist persons desiring fuller information on the subjects referred to.

These lectures are well illustrated by 196 very clear figures and views, consisting of photographic reproductions and drawings, mostly in full-page plates, with a few folding ones; and a fairly full synopsis of each lecture, together with a list of the illustrations at the commencement of the book, is considered to serve the purpose of an index. Valuable particulars about certain important municipal works will be found here and there in the book; but, whereas the two succeeding volumes, on pumps and gas works, are fairly well suited for the business objects of these lectures, owing to their appertaining so closely to mechanical engineering, the scientific, biological, and civil engineering aspects of municipal works have had to be, to a large extent, sacrificed to the main purpose of these publications.

In the second volume of this series, a brief introduction indicates the importance of pumping and hydraulic machinery, and the main points that should be considered in the selection of pumps under different conditions; and the author then proceeds to describe, with the aid of illustrations, the principal types of pumps and pumping engines made by the chief British firms, pointing out the special features to be borne in mind in buying them, and the particular sort of work for which each form of pump is best adapted. Eight distinct classes of pumps are described in separate sections, namely, pumps worked by hand, pumps driven by water-power and wind-power, gas and oil engine, hot-air, and compressed air-pumps, electrically-driven pumps, and steam-pressure pumps; and the different forms of pumps in each class are given with the names of their makers, together with allusions to their merits in special cases, and any deficiencies in respect to certain conditions of work. Electricity is being rapidly extended as a motive power for pumps, especially for underground working in collieries and mines, and where the power has to be transmitted to a considerable distance; and the construction of directly-driven centrifugal pumps, pumps driven by single, double, and treble gearing, and by belt, the "Riedler" pump, and the sinking pump, is briefly explained. The descriptions of steam pumps occupy half the book, dealt with successively under the four types of direct-acting, rotative, pulsating, and rope- and belt-driven pumps. The book is illustrated by ninety-seven views and drawings of pumps, and at the end, after a short list of books on pumps and pumping-engines published in Great Britain, a directory of British manufacturers of these machines is given occupying twenty-one pages. As in the first volume, the table of contents and an unpaged list of plates are the only index provided in this and the succeeding volume; and the illustrated reference to the English De Laval centrifugal pumps

must have been added as an afterthought, as these pumps do not appear in the table of contents or in the list of plates. This volume should prove valuable in guiding persons requiring pumping machinery, both in the choice of the pump best suited to their requirements, and as to the firms from whom they can be purchased.

The third volume deals with the machinery employed in the various processes involved in the manufacture of coal-gas, such as the handling of coal, retorts, stoking, the removal of coke, condensers, exhausters, washer-scrubbers, purifiers, gasholders, and various gas appliances, with the names of the principal makers; but some of the subjects are referred to in a very cursory manner, two pages only being given, for instance, to water-gas plant, and also to the very important economic question of bye-products. The descriptions are illustrated by one hundred and thirteen views of plant and machinery; and following the principle adopted in the earlier volumes, a classified list of British gas-engineering literature is added at the end of the book, and also of British manufacturers of gasworks' plant and machinery, occupying respectively eleven and twenty-eight pages, amounting to two-fifths of the text of the book. The author holds very optimistic views as to the future of the gas industry, which he considers are borne out by the remarkable success of the recent Gas Exhibition at Earl's Court, and which, in spite of frequent gloomy prophecies of the injurious influence on it of the development of electric lighting, has more than doubled itself in the last twenty years.

Everything has been done on the publishers' part to render these volumes attractive, by very well reproduced illustrations, unusually large and wide-spaced print, good paper, neat binding, and a moderate price; and they may reasonably be expected to be very useful, from a commercial point of view, in making the scope and efficiency of British manufactures and machinery more fully known in the colonies and foreign countries, and thereby extending the range of British trade and engineering.

A STANDARD ATLAS OF ENGLAND AND WALES.

The Survey Atlas of England and Wales. A Series of 84 Plates of Maps and Plans, with Descriptive Text, illustrating the Topography, Physiography, Geology, Climate, and the Political and Commercial Features of the Country. Designed by and prepared under the direction of J. G. Bartholomew. (The Edinburgh Geographical Institute, 1903.) Price $2\frac{1}{2}$ guineas.

THIS sumptuous volume, which began to be issued in parts in 1903, is a credit to all concerned with its publication. Mr. Bartholomew and the Royal Geographical Society are to be congratulated on adding a work of great beauty as well as of scientific merit to the resources of all who have to study England and Wales. These are a majority of the thoughtful members of the community, for "know thy country" is a maxim next in importance in the modern world to "know thyself." A work which concentrates in one volume the materials for a close study of its surface anatomy and human settlements and routes, as well as a general survey of its resources and activities, is a precious possession, which will increase in value as years pass, for it is the most condensed, yet clear and precise, summary of certain aspects of the material condition of England and Wales at the beginning of the twentieth century which the future historian will find within reasonable compass. What would present historians not give for similar records of the England of past centuries?

The present work may be divided into four parts:—(1) general geographical maps; (2) detailed topographical maps; (3) town plans; and (4) text and tables.

(1) The general maps are more complete than in any other atlas, although most of them have been published previously in another form. The first plate, the oro-bathymetrical map, is a new one, and contains names for the outstanding features of the land which may be regarded as at least semi-official. They were selected by Dr. Mill and Messrs. Chisholm and Mackinder at the request of the Royal Geographical Society. It is convenient to have such a set of names, and undoubtedly the greater number, even of those which are new or have had an extended significance given to them, will be generally accepted. There are, however, one or two exceptions. The term gap, which has been familiarised to us in recent years, more particularly in American writings, can hardly be applied to the broad lowland between Wales and the Pennines, though it may be used for the valleys of the Tyne and Aire, which afford narrow but easy routes across the Pennines. Norfolk Edge and East Anglian Ridge are other terms which seem to imply more pronounced topographical features than they represent. The Vale of Pickering seems unduly extended into that of York. We fail to discover any very clear rule as to what features should and should not be named. We find the Vale of York, but not the Vale of Trent or Severn; the Vale of Taunton, but not of Pewsey. While it is a pity that something more systematic and complete has not been attempted, some of the names are distinctly happy and will remain.

The geological map is unfortunately on a smaller scale than that in the companion "Atlas of Scotland," and hardly shows sufficient detail unless for the country south of London, which is shown on an inset. A smaller scale map illustrates the distribution of old, young, and coal-bearing rocks and iron centres. It is clear, but coal and iron are shown in greater detail on a map of mineral products which comes later. Maps of vegetation, lands in pasture or in crops, afford material for a long chapter in geography and economics. The next two sheets show maps of monthly and annual rainfall and temperature, driest and wettest months, the annual range of temperature, and the annual temperature not reduced for altitude. The subsequent two sheets depict the railways in black, the spheres of influence of the various companies being shown by different tints. We welcome

an attempt to illustrate the areas tributary to each railway company, which, if properly done, would be a most valuable guide to business men. The present map is hardly successful in showing more than the obvious, and in the crowded area of south Lancashire and the West Riding of Yorkshire, even when shown on a larger scale in an inset, the method adopted does not do justice to some of the lines. No attempt has been made to distinguish areas which are served by more than one railway; nor does the compiler seem to have taken configuration into account in preparing the map. No doubt the details can be worked out on the half-inch maps which come later, but what might have been a very effective and useful map is somewhat spoilt. It resembles a rough railway company diagram rather than the other maps of the atlas.

The density of population maps by Mr. Bosse, in which the uninhabited area is first marked off, are clear, and reveal a multitude of points not indicated on maps which show the density of population by counties. They form a very effective contrast to two maps showing densities of agricultural, of industrial and commercial population by counties, which, however, summarise the more obvious contrasts of density and of distribution. Administrative divisions, political and ecclesiastical, a commercial and a mineral map end the first section of the atlas.

(2) It is scarcely necessary to direct attention to the merits of Bartholomew's half-inch contoured map, which everyone uses who cycles or motors. It is beautifully printed on sixty-seven sections. The contour lines, as on the Ordnance maps, are shown for every 100 feet up to 1000 feet, and for every 250 feet above that. The areas between each consecutive 100 feet up to 400 feet are tinted in shades of lighter and lighter green, between each 200 feet to 1000 feet, and then between each 250 feet, in deepening shades of brown, a purplish tint being used for the bands between 2750 feet and 3000 feet. This is a reasonable compromise, but for students of orographical features a single colour in different shades would give a clearer picture. The great defect of our Ordnance maps is the absence of a closer contour interval, and for the inadequacy of the existing data in exhibiting the characteristics of the relief Mr. Bartholomew cannot be held responsible.

These maps are wonderfully accurate; in some places they are more up to date than the survey sheets. Only here and there have we detected minor errors. The arrangement of the sections in the atlas is confusing. The numbers zigzag in such a way that it is not possible, without turning to the sheet inside or to the key map, to discover whether they run eastwards or westwards. This difficulty might have been avoided by printing a key map beneath the number outside each sheet and shading the area of the section drawn inside.

(3) The town plans call for little comment, except that they should have been on a uniform scale.

(4) The text consists of clear descriptions of the physical features in relation to political and commercial development by Dr. Mill, with one or two slips, and of the geological features by Sir Archibald Geikie; temperature and rainfall tables for more than a hundred stations (the latter, unfortunately, only for a ten years' mean); agricultural, population, ecclesiastical, demographic, political, commercial, industrial, and railway statistics; a list of railways; the etymology of English and Welsh place-names; and an invaluable bibliography of the maps of the country from the earliest times, specially compiled by Mr. Bartholomew.

It will be seen that the atlas deserves its comprehensive title. The time and art required to produce it have been great, and Mr. Bartholomew very properly makes due acknowledgments to his skilled assistants. The execution is admirable, and the work is not merely one of great scientific importance, but also a specimen of cartography worthy of the reputation of the house of Bartholomew.

LEATHER FOR BOOKBINDING.

Report of the Committee on Leather for Bookbinding. Edited for the Society of Arts and the Worshipful Company of Leathersellers by the Right Hon. Viscount Cobham and Sir Henry Trueman Wood. Pp. 120. (London: George Bell and Sons, 1905.) Price 10s. 6*d*.

In recent years there has been considerable dissatisfaction with the quality of leather used for bookbinding; although many old books have their bindings still in good condition, others more recently bound have become dilapidated. In 1899 the School of Arts and Crafts formed a committee for the investigation of the subject, which appealed later to the council of the Society of Arts requesting it to undertake a thorough examination of the whole question, and in February, 1900, the society agreed to appoint a committee for the purpose. The first meeting was held in May, 1900, and two subcommittees were elected from the members; the first, consisting of Mr. Cyril Davenport, of the British Museum Library; Dr. J. Gordon Parker, director of the London Leather Industries' Research Laboratories; Mr. A. Seymour-Jones, leather manufacturer; Mr. W. J. Leighton, bookbinder; and Mr. Douglas Cockerell, bookbinder, was to visit various libraries to ascertain the comparative duration of various leathers used at different periods and preserved under different conditions. The second subcommittee consisted of Dr. J. Gordon Parker, Prof. Henry R. Procter, professor of leather industries at Leeds University, and Mr. A. Seymour-Jones; its duty was to ascertain the cause of any deterioration noticed and to suggest methods for its prevention. Mr. M. C. Lamb, director of the leather dyeing and finishing department of Herold's Institute, was afterwards added to this committee.

The committee reported in June, 1901, and the report was printed in the *Journal* of the Society of July 5. It was considered desirable to reprint the report in a more permanent form, and with the financial assistance of the Leathersellers' Company the present volume has been produced, which contains more detailed accounts of the work of the subcommittees

than were contained in the appendices to the original report.

It was found that all the bindings examined showed evidence of decay, but the books bound during the last 80 or 100 years were in a worse condition than many of those of an earlier date; some recent binding had deteriorated in as short a period as five years. The deterioration became more general in books bound after 1830; some leather seemed to be good until 1860, after which date nearly all leather appeared to get worse.

Besides the quality of the leather, the conditions under which books are kept have a great influence on the durability of the bindings. When ventilation is good and artificial light is not used the books are in a better condition. The products of the combustion of gas do much mischief, especially on the upper shelves of a library, where the temperature is often considerably raised by the heat from the flames. Sad to relate, tobacco smoke is said to be deleterious. Daylight, and especially direct sunlight, has a bad effect on some leathers and also on the colours of the dyes.

The report discusses fully the durability of the different kinds of leathers which have been used for bookbinding and also the construction of bindings; a specification for binding heavy or valuable books and also one for ordinary library binding are given.

The second subcommittee investigated the cause of decay by many experiments. Three different kinds of skins were tanned with eleven different agents, the tanning process being modified in portions of the specimens. Small strips of the leathers were fastened on boards with one half of each strip exposed and then submitted to various actions—direct sunlight, light from a fish-tail gas-burner, light from an incandescent gas-burner and from an incandescent electric lamp, the fumes and heat of burning gas, currents of moist and dry air alternately in a closed vessel kept at a temperature of 60° to 70° F., carbonic acid gas, and sunlight, but protected from air by glass; the results of many of these experiments are shown by excellent coloured plates.

Experiments were made with purchased leathers, most of which were found to contain free sulphuric acid; this acid has been used of recent years for brightening the colour of bark-tanned calf, from which it removes the iron and tan stains, and much improves the appearance of the material. It was found that in every case the presence of sulphuric acid hastened the destruction of the leather by all the agents tried. The sulphuric acid cannot be entirely removed from the leather by washing with water; a piece of leather containing 1 per cent. of sulphuric acid was washed for five days and nights in running water, and was afterwards found to contain one-fifth of the original quantity of acid. It was found, however, that if leather containing sulphuric acid is washed with potassium or sodium lactate or acetate the effects of the sulphuric acid are neutralised.

Sulphuric acid is also introduced into leather by the pickling which is used for preserving skins that are imported from New Zealand and Australia, the process consisting of acting on the skins with a solution of salt and sulphuric acid. Mr. Seymour-Jones has shown that formic acid may be used in the place of sulphuric acid, and is quite as efficacious. Sulphuric acid is employed in the dye bath for the purpose of liberating certain colours; it has been found that in this case also formic acid may be substituted.

Mr. Seymour-Jones has made a number of determinations of the mechanical strength of skins in their original condition, and also after tanning and other processes; it was found that the breaking stress of the leather is always below that of the original skin.

Valuable sections on the preparation of leather suitable for bookbinding, on bookbinding, and on the preservation of books appear in the report. Appendix i. consists of hints to owners and keepers of libraries by the chairman, Lord Cobham. Appendix ii. is on the fading of colour from sumach-tanned leather dyed with coal-tar colours, by Mr. M. C. Lamb, and is illustrated by coloured plates.

The book is excellently printed and illustrated, and inside the cover are specimens of six varieties of leather in their undyed and dyed conditions. The report should be read by all interested in books and libraries.

H. M.

OUR BOOK SHELF.

A Treatise on Ore and Stone Mining. By Sir C. Le Neve Foster. Sixth edition, revised and enlarged by Bennett H. Brough. Pp. xxx+799. (London: Charles Griffin and Co., Ltd., 1905.) Price 34*s*.

THIS book, when it first appeared in 1894, was the first systematic treatise on mining published in England, and was quite up to date; but later editions were not sufficiently revised, and the hand of death put an end to the gifted author's intentions of re-writing the work. The preparation of a new edition could not have been entrusted to more competent hands than those of his old colleague Mr. Bennett H. Brough. The general arrangement of the book is the same as in former editions, except that chapter xiv., "Principles of Employment of Mining Labour," has become chapter xvii.

The revision of the whole work has been very thorough; recent discoveries of important occurrences of minerals and new methods of mining and treating ores have been brought up to date, while other methods, machinery and appliances, which have been superseded during the last few years, are omitted from this edition.

Additions to the work are interspersed throughout, so that it is difficult to make selections. More prominence is given to the important iron-ore deposits of Sweden and Norway, also to those of Spain. The various kinds of steam turbines, which may, under certain conditions, be used to advantage as motors for pumps, are briefly described. A considerable addition has been made to the list of important percussive rock drills now on the market. The Water Leyner rock drill with its water-flushing apparatus, which tends to prevent miners' phthisis, is introduced to the reader, and the recent important investigations of Dr. Haldane and Mr. Thomas into the mortality of Cornish miners receive the attention they deserve.

We find no mention in chapter vii.—"Haulage"—of Koppel's hydroleum steam locomotive, which is in use at some mines in Great Britain and elsewhere for underground haulage, and deserves to be better known. A 10-horse-power locomotive costs 285*l*., and burns on an average $1\frac{1}{2}$ gallons an hour of crude petroleum, which can be bought for 3*d*. a gallon. Acetylene hand lamps (p. 544) are also used at some of the mines in Great Britain, while one mine at least has had its pass-byes illuminated for years by 30-candle-power acetylene burners supplied from a small generating plant.

We would warn the mining student not to make a pilgrimage to the Frongoch Mine, mentioned more than once, as, unfortunately, the whole of the fine electrical and dressing plant has passed under the auctioneer's hammer and been dismantled.

The amount of accurate and up-to-date information contained in this volume is enormous. No mining student at home can afford to neglect it, and it is a library in itself to mining engineers who go abroad.

The Useful Plants of the Island of Guam. By W. E. Safford. Pp. 416. (Washington: Government Printing Office, 1905.)

DURING the last few years there has been a remarkable advance in the application of scientific knowledge to the cultivation of economic products, and as a result there has arisen a demand for authoritative books providing accurate and recent information. The Department of Agriculture in the United States of America has taken the lead with its useful series of bulletins of an eminently practical nature. In addition there is need of handbooks, similar to this volume by Mr. Safford, which give a comprehensive account of the products of a country or colony. Dr. Watt's dictionary of the economic products of India is a monumental compilation dealing with an area that embraces tropical, subtropical, and mountainous regions, and describes not only indigenous products, but another fifty per cent. of introduced plants; in its present form, size and cost preclude its general use, although it is a valuable work of reference.

The island of Guam, about 100 miles in circumference, is the largest of the Ladrone or Marianne Islands, and passed into the possession of the Americans after the late war, while the rest of the islands were sold by Spain to Germany. The author had many opportunities of studying the islanders and different parts of the island, and made excellent use of this advantage, so that his information is the result of personal observation and inquiry. The introduction, forming nearly half the book, contains a general account of the history, physical conditions, vegetation, fauna, and ethnology, while in the second part is given an alphabetical list of plants with vernacular names and descriptions. Mr. Safford formed a very favourable opinion of the islanders. Agriculture is universally pursued, and even the artificers leave their trade from time to time to attend to the *rancho*. Maize is the principal food crop, rice is grown, but not in sufficient quantity to supply the demand, and taro and yams are cultivated as well as tobacco. Coffee is grown round most of the habitations, requiring little attention, and plantains and bread-fruit thrive luxuriously. Although copra provides the only article of export, the number of economic plants that are indigenous or have been introduced is exceedingly large, so that the list of plants and the information provided would be useful in many tropical countries. Of fibre-yielding plants twenty-three are recorded, including pine-apple, ramie, kapok, cocoa-nut, plantain, Manila hemp, Sida and a Pandanus, but the most valued plant is *Hibiscus tiliaceus*, from which the natives make all their cordage and cables. The island will produce plenty of citrus and other fruits, and several farinaceous and oil-yielding plants were observed. The book is lavishly supplied with excellent illustrations and the information is readily obtainable; in fact, the volume supplies a good model for future compilations of a similar nature, the main defect being a somewhat unusual nomenclature, which does not, however, cause any difficulty in the determination of the plants referred to.

The British Journal Photographic Almanac and Photographer's Daily Companion for 1906. Edited by George E. Brown. (London: Henry Greenwood and Co., 1905.) Price 1*s*. net; 1*s*. 6*d*. cloth.

THE present issue of this year-book appears under the direction of a new editor, Mr. G. E. Brown, but the contents in no way suffer from this change. As has always been the case, and still is, this work is a compendium of everything pertaining to photography, and the photographer would be at a loss if he had not the volume near at hand for ready reference. Under the new guidance, the material brought together is all that could be desired, and in order that any particular portion of it can be looked up at once there is a full "contents" and an elaborate index.

Other features of this annual consist in a capital popular account of photographic copyright as it exists to-day, a most interesting and varied "epitome of progress," being a survey, logically classified, of the year's labour in both technical and scientific photography, and articles contributed by leading writers. The directory of photographic societies, formulæ for the principal photographic processes, and other facts have all been secured and brought up to date, rendering the volume indispensable to the busy photographer.

Nature in Eastern Norfolk. By Arthur H. Patterson. Pp. vii+352. (London: Methuen and Co., 1905.) Price 6*s*.

THIS book contains some very pleasant reading, for Mr. Patterson is a born naturalist, and writes with freshness and enthusiasm. Not the least interesting chapter is the autobiographical one, in which the author tells the story of his early passion for natural history, his painful struggles to gratify it, and his later misadventures, with much relish and humour. We gather that he has at last settled down to a homely life in his beloved native town, and hope that he may long continue in it. The second chapter, general observations on the fauna, is also very good reading, and here the human species is well represented by short but vigorous sketches of old punt-gunners and bird-catchers. The rest of the book is occupied with lists of birds, mammals, fishes, &c.; these naturally do not offer much that is new in a district that has been so thoroughly worked as east Norfolk, but they are often enlivened by anecdotes or personal reminiscences. The discovery of the black rat (*Mus rattus*) as a common species in Yarmouth is extremely interesting, and still more so is the occurrence of a few specimens of *M. alexandrinus*, its southern variety. Other contributions of Mr. Patterson to the natural history of the district are to be found in these pages; most of them are already known to members of the Norfolk and Norwich Naturalists' Society.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The British Association and our Colonies.

PROF. MILNE's letter in NATURE of November 23 (p. 77) will be read with pleasure by all scientific people in the colonies. The benefits to be derived from a colonial meeting such as he suggests are many and various, and I have no doubt will receive full consideration should the idea be given effect to.

Here in Africa, one piece of work which the British Association is the natural body to take up is that of the magnetic survey of the whole continent. The great lack of trustworthy data for immense tracts of this continent has been often commented on. When we remember how much of the continent is in British hands, and how the British Association since its inception has steadily helped and encouraged the study of earth magnetism, the fitness of bringing such a proposal before the association is apparent. At such a conference the possibility of a simultaneous magnetic survey of Australia would naturally be considered. Could these two surveys be carried out—even if very incompletely—they, with the surveys at present in progress and with the proposed ocean surveys of the Carnegie Institution, would form an invaluable contribution to our present knowledge of earth magnetism.

Africa has many other problems—educational, explorational, meteorological—the solution of which would be helped were they taken up at such a conference.

J. C. BEATTIE.

South African College, Cape Town, December 12, 1905.

Monotremes and Birds.

IN Semon's *Zoologische Forschungsreisen*, Lieferung xxii. (1904), Disselhorst treats of "Die maennlichen Geschlechtsorgane der monotremen und einiger Marsupialen." On p. 123 are two text figures, both copied from Sir Everard Home, *Phil. Trans.*, 1802, plate xii. One represents the male genital apparatus of *Echidna hystrix*, the other, Fig. 1B of the German work, the stretched male organ of the same animal. Now this Fig. B is, in Home's paper, correctly named "penis of the Drake." Needless to say, this Drake's organ does not in the least agree with that of Echidna, as which it is described in the German work, and our author is sorely puzzled about some of the details, *cf.* p. 131. This may well be the case. Errors and blunders have been made ere now, but the serio-comic point is that this Drake figure has, in the process of reproduction, assumed mammalian characters. In the original figure the base is surrounded by well-drawn feathers, and such are mentioned in the explanation of the plate. The thing is also correctly copied by Owen in his article Aves in Todd's "Cyclopædia," further in the "Anatomy of Vertebrates," vol. ii., Fig. 119, and Owen directs attention to an important error committed by Home in his interpretation of the urethra. But in the recent figure, wrongly attributed to Echidna, the feathers have lost their character as such, and have turned into hairy structures! Who has done this? The author or the artist, or have both combined to correct the faulty original? It is such a strikingly pretty figure that it is almost sure to be propagated, perhaps to be used as a proof of the affinity of the oviparous mammals. But a drake is a drake, for all that.

H. GADOW.

University Museum of Zoology, Cambridge, December 20.

Sounding Stones at Ch'üfu, Shantung.

LAST July I happened to pass through Ch'üfu, the birth- and burial-place of Confucius. In "seeing the sights" of the town I found three very fine examples of "sounding stones," or "stone gongs" as they are sometimes called. These particular examples do not seem to be very well known except by Chinese; none of my foreign acquaintances who have been in Ch'üfu had noticed them. Photo. No. 1 shows the tomb of the grandson of Confucius. The cover of the incense dish (on which my servant is resting his hand) is made from stone, but when struck with a stick, or even with the knuckles, it rings as though it were bronze. In fact, my man in the photograph refused to believe that it was anything but painted bronze until I myself assured him to the contrary. Photo. No. 2 shows two pillars (marked with crosses) of the balustrade in front of the principal hall of the great Confucian temple at Ch'üfu. Struck at any point with a piece of wood, they give a distinct musical note.

FIG. 1.—Grave of the grandson of Confucius Cemetery of the K'ung family, Ch'üfu, Shantung.

Inside the temple is a large tablet, about $5 \times 3 \times \frac{1}{2}$ feet, of the same stone. In this case the note produced varies according to the point at which the stone is struck. The stone from which all these bodies is made is a greyish oolitic limestone. I was informed that it came from a quarry at Kwan Ko Shan, about seventeen miles south-east of Ch'üfu. Most of the stone from this place has no musical quality, but from time to time veins of it are found, and when found it is usually abundant. "Stone gongs" of this kind are found in all parts of the country, and some are in the possession of foreigners. So far as I can find out, they all come from this one locality. They have been known for many centuries, and it is recorded that the district from which they come paid its share of a certain special Imperial tax in "sounding stones." I should be pleased if any reader could give the cause of this very remarkable property, and if it is not understood I would gladly give what help I can towards elucidating it. During this journey I was pressed for time, and as my route lay directly east from Ch'üfu I was not able to visit

FIG. 2.—Detail of Confucian Temple, Ch'üfu, Shantung.

the quarry. Should there be any object in doing so, however, I will take the first opportunity of returning and making any observations that I may be asked to make. Such an opportunity may occur at any time, and, in fact, could be easily made to occur, as the journey would only

take four days each way. I am afraid, however, that it might prove very difficult to secure any sample of this stone for transportation to Europe. Alfred Tingle.

Chinanfu, Shantung, China, November 9, 1905.

Auroræ of November 15 and December 12.

Since my communication of December 9 (Nature, December 28), I have learned that the aurora borealis of November 15 was observed here by several persons between 8.30 p.m. and 9.30 p.m., Halifax time. The appearances were similar to those noted in England (Nature, November 23, pp. 79–80), and the rosy-red streamers seem to have attracted special attention.

I am also informed that an aurora was observed here last night (December 12) at 9.30 p.m. with whitish streamers, but lacking the display of colour observed November 15.

It is somewhat noteworthy that the interval November 15 to December 12 covers a period of twenty-seven days—the time required for one complete rotation of the sun.

Alexander Graham Bell.

Beinn Bhreagh, near Baddeck, Nova Scotia, December 13, 1905.

The Principles of Heredity.

I have every reason to be satisfied with the kind and indulgent review (December 7, p. 121) by "A. D. D." of my book "The Principles of Heredity," but there is one sentence of it on which I should like to comment, more particularly as it contains nothing of blame or praise. "A. D. D." writes, "this book . . . is an embodiment of the recognition by medical men that they depend ultimately for a precise knowledge of nature on the professional biologist—who may or may not, at the same time, be a medical man."

But really I do not think that. On the contrary, I believe it is easily capable of demonstration that the information already in the hands of all medical men is incomparably superior, both in precision and volume, to anything ever possessed, or likely to be possessed, by biologists. It has not been utilised, that is all. The blame does not rest wholly with the medical man. His strictly professional curriculum is burdened by a monstrous but necessary load of facts. His one chance of coming in contact with subjects of general interest and of acquiring habits of sustained and accurate thought lies in the purely scientific part of his curriculum. Here his teachers are biologists who, instead of inculcating wide principles of heredity and evolution, add to the load on his memory by supplying irrelevant scraps of information about jelly-fish, earthworms, cockchafers, and the like—irrelevant, for, in the form they are presented, they do not link up with the studies and interests of his future career, and therefore are forgotten as soon as may be. "A. D. D." complains that I do not sufficiently appreciate classical teaching. It may console him to know that my appreciation of a certain class of scientific teaching is just as—well, hearty.

The biologist has surpassed the medical man in the study of great problems only because his attention has been directed to the subject, and because, on the whole, his habits of thought—not information—have been more precise. Had the medical man received the training of the biologist, or the biologist possessed the information common to medical men, the progress of science would have been much more rapid, and few or none of the great biological controversies of the past would have arisen, or at least have endured the interminable time they did; for example, the disputes as to whether natural selection is the cause or the sole cause of evolution, as to whether acquired characters are transmissible, as to whether variations are due to the direct action of the environment, as to whether evolution proceeds on lines of "fluctuating" variations or of discontinuous "mutations," as to the function of sex, and so forth.

Of necessity we—that is, all men—know the human type better than we can possibly know any other. Provided we know what to look for, extreme familiarity enables us to observe the smallest variations. No shepherd knows his flock, no biologist knows animal or plant as the medical man knows his fellow man. The species has diverged into a large number of natural varieties, dwelling under immensely diverse conditions and differing vastly in every peculiarity of body and mind. All these varieties, apparently, are inter-fertile, and almost all of them, in bulk or in isolated cases, have crossed with almost every other variety. Hybrids are being reared every day, and many races are compound hybrids—*e.g.* the Caucasian-Negro-Indian inhabitants of parts of South America. Above all, the species is being stringently selected and is undergoing rapid evolution under the action of disease, an agency which furnishes the most perfect series of experiments in heredity and evolution imaginable. Every race is resistant to every disease strictly in proportion to its past experience of it. Some diseases are short and sharp, others are of long duration. Some are local, others fill the whole system with micro-organisms or bathe the germ-cells with toxins. Many diseases are new to many races; others they have afflicted for thousands of years. If ever acquirements are transmitted, however "faintly and fitfully," it should be in the case of disease. If ever variations, no matter how small, are caused by the direct action of the environment, a race long afflicted should show the trace. If Mendelian phenomena play an important part in nature, we should note them in crossed varieties of men. If evolution proceeds on lines, not of fluctuating variations, but of stable mutations "which only selection can eliminate," then races (*e.g.* British) which have become highly resistant to this or that disease (*e.g.* consumption) should not constantly produce individuals who are as susceptible as members of a race which has undergone no such evolution (*e.g.* Red Indian).

Unless heredity in man differs from heredity in other species, it is very evident that medical men have no need to go to biologists for precise information, but that there is every need that biologists should go to medical men. A vast fund of minutely accurate data, much of which is statistical, is available. To grope in the obscurity that necessarily surrounds the past and the present of wild species or amid the confusion of the unrecorded crosses of domesticated varieties while this fund is untouched may be magnificent, but it is not science.

Southsea, December 11, 1905. G. Archdall Reid.

Dr. Reid takes exception to a passage in my review of his book; in it I state my belief that his book is the embodiment of a certain opinion, but Dr. Reid writes to say that he does not hold this view at all. It is not necessary, nor would it be profitable if it were, to discuss who is right in this matter—he or I—for obviously I am guilty of misrepresenting Dr. Reid's opinion.

But that the medical man is capable of acquiring a precise knowledge of nature independently of the information already gained and the methods employed by the biologist does not seem to me to be by any means certain. Dr. Reid thinks it is, and brings forward as evidence the fact that doctors possess better data for the solution of problems of evolution than ever have been, or can be, possessed by the biologist. Now, even supposing this to be true—which I do not for a moment—it does not seem to me to prove Dr. Reid's point. Either he thinks that the possession of data is tantamount to a precise knowledge of nature, or he does not; if he does, he proves his point by introducing into his syllogism a premiss which I believe to be untrue; if he does not—and I do not believe that he does—he does not prove his point.

But be this as it may, the point that interests me is that the belief that there is no great step between the collection of data and the derivation from them of a precise knowledge of nature is a widespread and, I believe, a profoundly erroneous one; for it seems to me that the possession of data is a small advance towards such a precise knowledge, and that that which hinders the acquisition of natural knowledge is not the slowness with which facts are accumulated, but the paucity of investigators capable of dealing with them properly; and this dearth is due to the infection of the majority of biologists by a disease—a sort of sleeping sickness—which consists in a disinclination to picture to the mind's eye the things represented by the words they use.

Let us proceed to examine Dr. Reid's main thesis—that

the medical man has better material for the study of evolution than any biologist has had or can have, for the reason, says Dr. Reid, that the animal about which we know infinitely more than we do about any other is man himself. And further than this, he maintains that a knowledge of the relation of man to disease has already furnished us with solutions to such problems as that of the inheritance of use and disuse, and others which he names. Now if the reader is familiar with Prof. Ray Lankester's Romanes Lecture, he will immediately see that great caution must be exercised.

Prof. Lankester in this lecture showed that, though man was a part of nature, he had separated himself from nature, and had set up for himself a *regnum hominis*, where, to use Huxley's terms, the cosmic process was replaced by the horticultural. Man had—if we may use a picturesque expression which has no meaning—disobeyed nature's laws, and had become in Prof. Lankester's words "nature's rebel."

Moreover, it was in the very matter of disease, on which Dr. Reid bases so much, that man had become more different from the rest of nature than in any other respect.

Disease has no existence in nature apart from man; the parasite either kills his host or an equilibrium is established between the two and both continue to live together; whereas in man a state of affairs has been evolved which is entirely peculiar to him, namely, disease.

Now I maintain that these considerations should prevent us from being too willing, or even from being willing at all, to argue from the data that medical men possess concerning the human species, and particularly from the data concerning man's relation to disease, to the rest of nature.

I am sometimes asked, "Is the knowledge of heredity which you acquire from your experiments with mice likely to be applicable to man?" In my opinion the question which the pure biologist should seriously consider before he accepts the truth of Dr. Reid's contention is, "Is the knowledge of heredity acquired by observation on man likely to be applicable to mice? Is that knowledge likely to help him towards a closer acquaintance with the fundamental nature of living things?" My answer is, that it may do to a certain degree, but not so surely as will the kind of knowledge acquired by the pure biologist—a knowledge of nature outside the *regnum hominis*.

Biologists are still very anthropomorphic, and medical men still more so. To the pure biologist man is not a more interesting animal than any other; and, in fact, it might be urged with some justice that as "nature's rebel" he is less so. I am well aware that this view will find no favour with Dr. Reid. On the other hand, Dr. Reid's estimate of the value of the breeding-pen, as an instrument for acquiring a knowledge of heredity, is likely to find as little favour with the experimental breeder. Yet who can say that the one has more of truth in his opinion than the other?

Naturally each one thinks that the point of view from which, and the material with which, he works at a problem is the best, but I am willing to concede to Dr. Reid the point that, considered as material for dealing with heredity, men are nearly as good as mice, if he will allow that mice are nearly as good as men. A. D. D.

A Suggested Change in Nomenclature.

In the *Geological Magazine* for October, 1904, I gave the name Barypoda to a new order of Ungulates, including under it Arsinoitherium and its allies. It has just been pointed out to me by Mr. W. K. Gregory, of the American Museum of Natural History, that this name was previously used by Haeckel ("Generelle Morphologie," ii., p. clvii.) for certain groups of extinct marsupials. It is therefore advisable to suggest another name for the new division of the Ungulates, and I propose that Embrithopoda be employed.

In the case of a generic name, it is comparatively easy to determine with reasonable certainty whether it has been previously used or not, but with the names of higher subdivisions this is very difficult, especially when, as in the present case, the term has never passed into current use.

CHAS. W. ANDREWS.

British Museum (Natural History), London, S.W., December 29, 1905.

NOTES ON STONEHENGE.[1]

X.—SACRED FIRES.

THE magnificent collection of facts bearing on this subject which has been brought together by Mr. Frazer in "The Golden Bough" renders it unnecessary for me to deal with the details of this part of my subject at any great length.

We have these records of fires:—

(1) In February, May, August and November of the original May year.

(2) In June and December on the longest and shortest days of the astronomical year (the solstices), concerning which there could not be, and has not been, any such change of date as has occurred in relation to the May year festivals.

(3) A fire at Easter in all probability added not long before or at the introduction of Christianity. I find no traces of a fire festival at the corresponding equinox in September.

We learn from Cormac that the fires were generally double and that cattle were driven between them.

Concerning this question of fire, both Mr. Frazer and the Rev. S. Baring-Gould[2] suggest that we are justified in considering the Christian treatment of the sacred fire as a survival of pagan times. Mr. Baring-Gould writes as follows:—"When Christianity became dominant, it was necessary to dissociate the ideas of the people from the central fire as mixed up with the old gods; at the same time the central fire was an absolute need. Accordingly the Church was converted into the sacred depository of the perpetual fire."

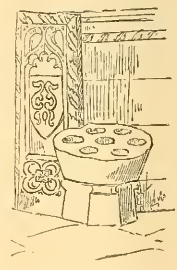


FIG. 24.—Cresset-stone, Lewannick. From Baring-Gould's "Strange Survivals."

He further points out that there still remain in some of our churches (in Cornwall, York, and Dorset) the contrivances—now called cresset-stones used. They are blocks of stone with cups hollowed out. Some are placed in lamp-niches furnished with flues. On these he remarks (p. 122):—

"Now although these lamps and cressets had their religious signification, yet this religious signification was an afterthought. The origin of them lay in the necessity of there being in every place a central light, from which light could at any time be borrowed; and the reason why this central light was put in the church was to dissociate it from the heathen ideas attached formerly to it. As it was, the good people of the Middle Ages were not quite satisfied with the central church fire, and they had recourse in times of emergency to others—and as the Church deemed them—unholy fires. When a plague and murrain appeared among cattle, then they lighted need-fires from two pieces of dry wood, and drove the cattle between the flames, believing that this new flame was wholesome to the purging away of the disease. For kindling the need-fires the employment of flint and steel was forbidden. The fire was only efficacious when extracted in prehistoric fashion, out of wood. The lighting of these need-fires was forbidden by the Church in the eighth century. What shows that this need-fire was distinctly heathen is that in the Church new fire was obtained at Easter annually by striking flint and steel together. It was supposed that the old fire in a

[1] Continued from p. 155.

[2] "Strange Survivals," p. 120 *et seq.*

twelvemonth had got exhausted, or perhaps that all light expired with Christ, and that new fire must be obtained. Accordingly the priest solemnly struck new fire out of flint and steel. But fire from flint and steel was a novelty; and the people, Pagan at heart, had no confidence in it, and in time of adversity went back to the need-fire kindled in the time-honoured way from wood by friction, before this new-fangled way of drawing it out of stone and iron was invented."

The same authority informs us that before Christianity was introduced into Ireland by St. Patrick there was a temple at Tara "where fire burned ever, and was on no account suffered to go out."

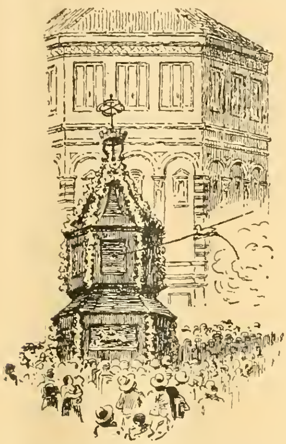


FIG. 25.—The Carro, Florence. From Baring-Gould's "Strange Survivals."

Mr. Frazer,[1] quoting Cerbied, shows that in the ancient religion of Armenia the new fire was kindled at the February festival of the May year, in honour of the fire god Mihr. "A bonfire was made in a public place and lamps kindled at it were kept burning throughout the year in each of the fire-god's temples." This festival now takes place at Candlemas, February 2.

We must assume, then, that the pagan fires were produced by the friction of dry wood, and possibly in connection with an ever-burning fire. In either case the priests officiating at the various circles must have had a place handy where the wood was kept dry or the fire kept burning, and on this ground alone we may again inquire whether such structures as Maeshowe at the Stenness circle, the Fougou at that of the Merry Maidens, and indeed chambered barrows and cairns generally, were not used for these purposes amongst others; whether indeed they were not primarily built for the living and not for the dead, and whether this will explain the finding of traces of fires and of hollowed stones in them, as well as some points in their structure. Mr. MacRitchie[2] has brought together several of these points, among them fireplaces and flues for carrying away smoke.

At both solstices it would appear that a special fire-rite was practised. This consisted of tying straw on a wheel and rolling it when lighted down a hill. There is much evidence for the wheel at the summer but less at the winter solstice; still, we learn from the old Runic *fasti* that a wheel was used to denote the festival of Christmas. With regard to the summer solstice I quote the following from Hazlitt (under John, St.):—

"Durandus, speaking of the rites of the Feast of St. John Baptist, informs us of this curious circumstance, that in some places they roll a wheel about to signify that the sun, then occupying the highest place in the Zodiac, is beginning to descend. 'Rotam quoque hoc die in quibusdam locis volvunt, ad significandum quod Sol altissimum tunc locum in Cœlo occupet, et descendere incipiat in Zodiaco.' Harl. MSS. 2345 (on vellum), Art. 100, is an Account of the rites of St. John Baptist's Eve, in which the wheel is also mentioned. In the amplified account of these ceremonies given by Naogeorgus, we read that this wheel was taken up to the top of a mountain and rolled down thence; and that, as it had previously been covered with straw twisted about it and set on fire, it appeared at a distance as if the sun had been falling from the sky. And he further observes, that the people imagine that all their ill-luck rolls away from them together with this wheel. At Norwich, says a writer in *Current Notes* for March, 1854, the rites of St. John the Baptist were anciently observed, 'when it was the custom to turn or roll a wheel about, in signification of the sun's annual course, or the sun, then occupying the highest place in the Zodiac, was about descending.'"

At Magdalen College, Oxford, the May and June years are clearly differentiated. There is a vocal service at sunrise on May morning, followed by boys blowing horns. At the summer solstice there is a sermon preached during the day in the quadrangle.

One of the most picturesque survivals of this ancient custom takes place at Florence each year at Easter. This is fully described by Baring-Gould. The moment the sacred fire is produced at the high altar a dove (in plaster) carries it along a rope about 200 yards long to a car in the square outside the west door of the cathedral and sets fire to a fuse, thus causing the explosion of fireworks.

The car with its explosives is the survival of the ancient bonfire.

It would appear that the lighting of these fires on a large scale lingered longest in Ireland and Brittany. A correspondent of the *Gentleman's Magazine* (February, 1795) thus describes the Irish Beltane fires in 1782, "the most singular sight in Ireland":—

"Exactly at midnight, the fires began to appear, and taking the advantage of going up to the leads of the house, which had a widely extended view, I saw on a radius of thirty miles, all around, the fires burning on every eminence which the country afforded. I had a farther satisfaction in learning, from undoubted authority, that the people danced round the fires, and at the close went through these fires, and made their sons and daughters, together with their cattle, pass through the fire; and the whole was conducted with religious solemnity."

It will have been observed with reference to these fire festivals that although there were undoubtedly four, in May, August, November, and February, those in May and November were more important than the others. This no doubt arose from the fact that at different times the May and November celebrations were *New Year* festivals. With regard to the New Year in November in Celtic and later times, Rhys writes as follows ("Hibbert Lectures," p. 514):—

"The Celts were in the habit formerly of counting winters, and of giving precedence in their reckoning to night and winter over day and summer (p. 360); I should argue that the last day of the year in the Irish story of Diarmait's death meant the eve of November or All-halloween, the night before the Irish *Samhain*, and known in Welsh as *Nos Galan-gaeaf*, or the Night of the Winter Calends. But there is no occasion to rest on this alone, as we have the evidence of Cormac's Glossary that the month before the beginning of winter was the last month; so that the first day of the first month of winter was also the first day of the year."

That the November bonfire was recognised as

1 "Golden Bough," iii. 248.
2 "The Testimony of Tradition."

heralding the dominion of the gods and spirits of darkness; that the old ideas surrounding Horus and Set in Egypt were not forgotten; is evidenced by the fact that when the fire was extinct the whole company round it would suddenly take to their heels, shouting at the top of their voices:—

Yr hwch du gwta A gipio 'r ola' !	The cropped black sow Seize the hindmost !

A piecing together of the folklore and traditions of different districts suggests that sacrifices were made in connection with the fire festivals, in fact that the fire at one of the critical times of the May year was a sacrificial one.

I will quote two cases given by Gomme[1] for May Day and All Souls' Day respectively:—

"At the village of Holne, situated on one of the spurs of Dartmoor, is a field of about two acres, the property of the parish, and called the Ploy Field. In the centre of this field stands a granite pillar (Menhir) six or seven feet high. On May-morning, before daybreak, the young men of the village used to assemble there, and then proceed to the moor, where they selected a ram lamb, and after running it down, brought it in triumph to the Ploy Field, fastened it to the pillar, cut its throat and then roasted it whole, skin, wool, &c. At midday a struggle took place, at the risk of cut hands, for a slice, it being supposed to confer luck for the ensuing year on the fortunate devourer. As an act of gallantry the young men sometimes fought their way through the crowd to get a slice for the chosen amongst the young women, all of whom, in their best dresses, attended the Ram Feast, as it was called. Dancing, wrestling, and other games, assisted by copious libations of cider during the afternoon, prolonged the festivity till midnight."

In the parish of King's Teignton, Devonshire, "a lamb is drawn about the parish on Whitsun Monday in a cart covered with garlands of lilac, laburnum, and other flowers, when persons are requested to give something towards the animal and attendant expenses; on Tuesday it is then killed and roasted whole in the middle of the village. The lamb is then sold in slices to the poor at a cheap rate."

The popular legend concerning the origin of this custom introduces two important elements a reference to "heathen days" and the title of "sacrifice" ascribed to the killing of the lamb (p. 31).

"At St. Peter's, Athlone, every family of a village on St. Martin's Day kills an animal of some kind or other; those who are rich kill a cow or sheep, others a goose or turkey, while those who are poor kill a hen or cock; with the blood of the animal they sprinkle the threshold and also the four corners of the house, and 'this performance is done to exclude every kind of evil spirit from the dwelling where the sacrifice is made till the return of the same day the following year'" (p. 163).

Other traditions indicate that human sacrifices were in question and that lots were drawn, or some other method of the choice of a victim was adopted. I quote from Hazlitt (i., 44) the following report of the Minister of Callender in 1794:—

"The people of this district have two customs, which are fast wearing out, not only here, but all over the Highlands, and therefore ought to be taken notice of, while they remain. Upon the first day of May, which is called Beltan, or Bàl-tein-day, all the boys in a township or hamlet meet in the moors. They cut a table in the green sod, of a round figure, by casting a trench in the ground of such a circumference as to hold the whole company. They kindle a fire, and dress a repast of eggs and milk in the consistence of a custard. They knead a cake of oatmeal, which is toasted at the embers against a stone. After the custard is eaten up, they divide the cake into so many portions, as similar as possible to one another in size and shape, as there are persons in the company. They daub one of these portions all over with charcoal, until it be perfectly black. They put all the bits of the cake into a bonnet. Everyone, blindfold, draws out a portion. He who holds the bonnet is entitled to the last bit. Whoever draws the black bit is the devoted person, who is to be sacrificed to Baal, whose favour they mean to implore, in rendering the year productive of the sustenance of man and beast. There is little doubt of these inhuman sacrifices having been once offered in this country as well as in the East, although they now pass from the act of sacrificing, and only compel the devoted person to leap three times through the flames; with which the ceremonies of the festival are closed."

[1] "Ethnology in Folklore," pp. 32 and 163.

I may conclude this article by referring to similar practices in Brittany, where Baring-Gould has so successfully studied them.[1]

The present remnants of the old cult in the different parishes are now called "Pardons"; they are still numerous. I give those for the May and August festivals (p. 83):—

MAY.

Ascension Day	Bodilis, Penhars, Spezet (at the Well of S. Gouzenou), Landevennec, Plougonnec.
Sunday after Ascension Day	Trégoat, St. Divy.
Whit Sunday	Kernilis. Plouider; Edern; Coray; Spezet (Chapel of Cran).
,, Monday	Quimperlé (Pardon des Oiseaux); Pont l'Abbé (Pardon des Enfants); Ergué-Armel, La Forêt, Landudal, Ploneis, Landeleau, Carantec.
,, Thursday	Gouezec (Les Fontaines).

AUGUST.

First Sunday in August ...	Pleyben (horse races); Plébannalec; Pouldreuzic; Plougomelin; Huelgoët; S. Nicodème in Plumeliau (M.), Cattle blessed; second day horse fair, and girls sell their tresses to hair merchants.

Judging by the "pardons," the solstitial celebrations are not so numerous as those connected with the May year. The bonfire is built up by the head of a family in which the right is hereditary. The fire has to be lighted only by a pure virgin, and the sick and feeble are carried to the spot, as the bonfire flames are held to be gifted with miraculous healing powers. When the flames are abated, stones are placed for the souls of the dead to sit there through the remainder of the night and enjoy the heat. "Every member of the community carries away a handful of ashes as a sovereign cure for sundry maladies. The whole proceeding is instinct with paganism" (p. 75).

With regard to the accompanying sacrifices, we read:—"In ancient times sacrifices were made of cocks and oxen at certain shrines now they are still presented, but it is to the chapels of saints. S. Herbot receives cows' tails, and these may be seen heaped upon his altar in Loqeffret. At Coadret as many as seven hundred are offered on the day of the 'pardon.' At S. Nicolas-des-Eaux, it is S. Nicodemus who in his chapel receives gifts of whole oxen, and much the same takes place at Carnac."

NORMAN LOCKYER.

[1] "A Book of Brittany."

SCIENTIFIC EXPLORATION IN CENTRAL ASIA.[1]

IT is with a lingering feeling of regret that we recognise how different, of necessity, are the explorations of the present day from those of fifty years ago. No longer is it possible, except in rare instances, for a traveller to return with tales of new discoveries of lakes, sources of rivers, mighty peaks, and of the strange peoples that dwell there. Much work still remains, but it is of a more scientific nature, and therefore will probably provide matter which when published may be less entertaining and less widely read. When a traveller makes a speciality of one particular branch of science, as Dr. Gottfried Merzbacher does in his volume on "The Central Tian-Shan Mountains," to the almost entire exclusion of all others, it follows that he can only appeal to a limited number of readers; to those, in fact, who are interested in the study of geology and glaciers. We would, however, make this reservation, that the photographs which adorn this book are exceptionally beautiful representations of snow scenery, and will more than satisfy the ordinary reader as well as the man of science, and that the map is of great general value.

For two seasons, 1902–3, did Dr. Merzbacher and his companions labour in the central Tian-Shan Mountains which lie north-east of Kashgar. Russian explorers have visited this district many times, but the main backbone of the range has never been closely explored, and Dr. Merzbacher was able to discover and correct many errors in existing maps. We would here point out the growing necessity for the closer interchange of information between the various scientific societies of different countries. Dr. Merzbacher met a Russian expedition which to his delight was not intending to work over quite the same tract of country, while Dr. Friedrichsen and Signor Giulio Brocherel have already published the results of their explorations of the same range, which were being undertaken almost simultaneously with those of Dr. Merzbacher and his companions. Healthy rivalry is to be encouraged, but such overlapping of work as this is regrettable.

In this volume, which is of the nature of a preliminary report, Dr. Merzbacher has embodied observations on the present and past glacier conditions of the Tian-Shan Mountains, and on peculiarities in the physical features of its valley formations, subjects to which, throughout the expedition, his attention was specially directed. A more detailed report, however, is to follow when his rich collections have been scientifically examined and arranged. We trust that the botanical, zoological, and climatological observations, which have been almost entirely omitted from this volume, will be included in the more detailed report. We cannot help feeling that a preliminary volume, such as this is intended to be, should have included some reference to these other subjects, while some of the geological and glacial notes might have been left to the more detailed report.

The care with which Dr. Merzbacher explored is worthy of the highest praise, leaving little or nothing for any future travellers in this region to accomplish. He made his winter quarters at Kashgar, but was not content to wait for more clement weather, and made many useful excursions during the winter months, which happened to be unusually mild. It would be out of place to attempt here a description, however short, of his journeyings, and indeed, without a map, it would be nigh impossible to follow any such description. Each glacier, each valley, each ridge is in turn visited, surveyed, and described. The position of the great peak of Khan-Tengri

FIG. 1.—Telephotographic View of Khan-Tengri (about 23,600 feet), taken from North, from the Middle Course of the Bayumkol Valley. Distance about 24 miles. From "The Central Tian-Shan Mountains, 1902–1903."

[1] "The Central Tian-Shan Mountains, 1902–1903." By Dr. Gottfried Merzbacher. Pp. ix+285. (London: John Murray.) Price 12s. net.

(23,622 feet) was correctly fixed, and the discovery was made that this, the culminating eminence of the whole Tian-Shan, does not stand in the main watershed, and is not a nucleus of converging ranges, but is situated on a secondary spur which projects from the main range far to the south-west. The true "nucleus" is the so-called "Marble Wall," which in lieu of a better name Dr. Merzbacher has christened after the president of the Imperial Russian Geographical Society Mount Nicholas Mikhailovich! The Inylchek glacier was found to have a total length of from forty-three to forty-six miles, in place of six to eight miles as previously supposed, and another equally large glacier was discovered but not visited. In the matter of climbing Khan-Tengri, which has been sometimes wrongly assumed to have been the main object of this expedition, Dr. Merzbacher points out the difficulties, which will probably have the result of exciting someone to make the attempt.

An accident which resulted in the unfortunate destruction of many photographic plates gave the energetic traveller an excuse for revisiting some of the ground already traversed, and enabling him, owing to the finer weather, to take still better photographs. Dr. Merzbacher's visit to the alpine lakes, such a rare phenomenon in the central Tian-Shan, and his notes thereon are of great interest, but as winter was closing in work became more difficult, and the expedition finally reached Tashkent *viâ* Kulja.

Regarding this volume as a preliminary report Dr. Merzbacher deprecates drawing conclusions from the facts noted until his rich materials have been examined by competent experts. He however mentions one point on which his scientific conviction is settled once and for all, namely, that for the Tian-Shan also an Ice age has to be accepted.

Photography was used on this expedition to an unprecedented extent, many beautiful views being due to the telephotographic process, which was used with excellent results. In addition to botanical and zoological collections climatic observations were taken twice daily, while the map was compiled with great care, and is also well drawn and beautifully reproduced. It is a pity that the same symbol should have been used to denote permanent villages and the pasturages, which are only visited at certain seasons by the Kirghiz herdsmen.

This volume, which is published under the authority of the Royal Geographical Society, is a worthy record of scientific work carried out under great difficulties. The author is to be warmly congratulated.

A LARGE-HEADED DINOSAUR.

THE mounted skeleton of *Triceratops prorsus*, of which a note by Mr. Charles W. Gilmore, preparator to the department of geology in the United States National Museum, Washington, has recently been published[1] with two plates, is interesting as displaying another Dinosaur of a distinct and very remarkable type, differing entirely from the numerous series of bipedal forms with which we are now familiar from the reconstructed skeleton of the iguanodon and its allies, and also from the ponderous quadrupedal, long-necked, small-headed Diplodocus, Brontosaurus, and Cetiosaurus types of gigantic herbivorous reptiles. Compared with these latter, Triceratops was a quadrupedal reptile of quite moderate size, the skeleton, according to the late Prof. Marsh, being not more than 25 feet in length and 10 feet in height. The present reconstruction by Mr. Gilmore still further reduces its length by the omission of six of the presacral vertebræ (introduced by Prof. Marsh), so that, as now restored, its total length is only 19 feet 8 inches.

The striking feature, which remains unchanged, is the skull, which is fully 6 feet long, and is consequently just one-third of the entire length of the skeleton as now set up.

Two powerful horn-cores of the bovine type, $2\frac{1}{2}$ feet in length, rise from the frontal bones of the skull, at the base of which are the round bony orbits. The snout is narrow and pointed, and carries a third smaller horn upon the nasal bone. Behind the pair of frontal horns is an immense frill of bone spreading back over the occipital region and covering the first six cervical vertebræ; it was 2 feet 6 inches long and 3 feet broad, resembling an immense Elizabethan ruff, ornamented with about twenty-four pointed bosses of bone along its border. The rostrum and predentary bones were armed with pointed horny beaks, the teeth being confined to the maxillary and dentary bones, forming a single series in each jaw. They are remarkable as having two distinct fangs, placed transversely in the jaw, with distinct sockets, and are displaced vertically; the successional teeth cut their way between the alveolar margin and the adjacent root of the old tooth, or between the two roots. Prof. Marsh had published a restoration of this dinosaur in 1891 (see *Geol. Mag.*, plate vii.), the chief difference between which and the present skeleton set up by Mr. Gilmore being the reduction in the number of the presacral vertebræ, already referred to, and the placing of the limbs, especially the fore-limbs (the humerus and the radius and ulna), in a

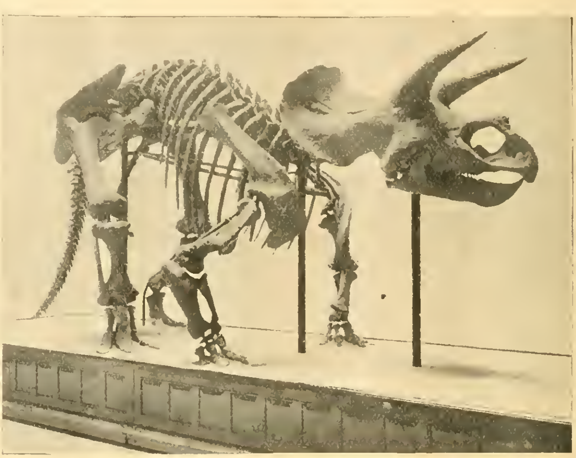


FIG. 1.—Skeleton of *Triceratops prorsus* in the U.S. National Museum. Three-quarters front view.

[1] *Proc. United States National Museum*, Washington, vol. xxix., pp. 433–435, with plates i. and ii., 1905.

more flexed and diverging position to enable the head of the animal in browsing to approach nearer to the ground. The bony cores on the skull were sheathed in horn as well as the beaks, and there is evidence of a dermal armature of bosses and spines which once covered the dorsal and lateral region of the creature's body. Mr. Charles R. Knight has given a spirited restoration of this animal in the *Century Magazine* (1897, p. 18). A life-size *papier-maché* reproduction of Triceratops has been made in America by Mr. Lucas, and it is to be hoped a copy may shortly be secured for the Natural History Museum in Cromwell Road. H. W.

NOTES.

THE King has conferred the honour of Knighthood upon Prof. A. Pedler, C.I.E., F.R.S., Director of Public Instruction, Bengal, and Vice-Chancellor of the Calcutta University.

WE are requested to announce that the endowment fund now being raised for the family of the late Prof. G. B. Howes, F.R.S., will be closed shortly, and all intending contributors are asked to send their contributions without delay to the treasurer, Mr. Frank Crisp, at 17 Throgmorton Avenue, London, E.C.

AT a meeting of the Academy of Natural Sciences of Philadelphia on December 5, 1905, Dr. Dixon announced that Mr. D. M. Barringer and Mr. B. C. Tilghman, members of the academy, had notified him of their discovery that the crater of Coon Mountain, or Coon Butte, in northern Arizona, twelve miles south-east of Cañon Diablo station on the Atchison, Topeka and Santa Fé Railway, is an impact crater, and not a crater produced by a steam explosion, as has been supposed since the examination made of it by members of the United States Geological Survey. It appears from their work that the large crater and elevation known as Coon Mountain is the result of a collision with the earth of a very large meteorite or possibly a small asteroid, fragments of which are well known to the scientific world by the name of the Cañon Diablo siderites. The investigations show (1) that the formation of the crater and the deposition of the meteoritic material were simultaneous; (2) that meteoritic material has been found 500 feet below the surface of the centre of the crater; (3) that sandstone supposed to be in place exists less than 1000 feet below the surface of the centre of the crater. The authors have presented to the academy for publication two comprehensive papers in which they set forth in full their reasons for the above statements.

A COPY of the programme of the excursions arranged in connection with the International Geological Congress, to be held in Mexico during next September, has just reached us. Excursions will take place before, during, and after the congress. Before the business meetings actually begin, four excursions are provided for visitors. The first excursion, which will last four days and be confined to 250 persons, is to be to the east from Mexico through Jalapa to Vera Cruz, returning to Mexico through Esperanza. The second excursion to the south is to extend to eight days, and is limited to 40 persons. Arriving at Esperanza, included in the first trip, the party will proceed to Tehuacan and thence to Oaxaca. Puebla will be taken on the return journey. The third excursion, confined to 30 members, will include visits to the volcanoes of Toluca, San Andrés, and Jorullo, and will last fourteen days, nine of which will be on horseback. The last of these trips is to the geyser district of Ixtlán and to the volcano, Colima. During the progress of the congress short journeys will be made to Pachuca, to Cuernavaca, and other places near Mexico. At the close of the conferences an excursion to the north, of twenty days, will take place. Salamanca, Guanajuato, Zacatecas, Mapimí, Conejos, Ciudad, Parras, and other localities will be visited. Another excursion after the meeting will be to the isthmus of Tehuantepec. The following subjects will be discussed at the congress:—(1) Climatic conditions during the geological epochs, when Messrs. G. Boehm, T. C. Chamberlin, W. B. Clark, W. H. Dall, W. M. Davis, A. Heilprin, V. Uhlig, and S. W. Williston will take part. (2) The relations between tectonics and eruptive masses: Messrs. A. Bergeat, A. Dannenberg, G. K. Gilbert, J. P. Iddings, A. Karpinski, A. Lacroix, and E. Naumann will speak. (3) The genesis of metalliferous veins: Messrs. B. von Inkey, F. Klockmann, W. Lindgren, W. B. Phillips, J. E. Spurr, and W. H. Weed will participate. (4) The classification and nomenclature of rocks: Messrs. Wh. Cross, J. P. Iddings, A. Karpinski, A. Lacroix, A. Osann, W. B. Phillips, H. S. Washington, and F. Zirkel will take part in the discussion. Communications may be addressed to the general secretary, M. Ezequiel Ordóñez, 5a del Ciprés, No. 2728, Mexico, D. F.

THE stone implements of the Zambesi valley near Victoria Falls, noted by Mr. Lamplugh in his report on the district (see NATURE, p. 112), and more fully described by Colonel Feilden in a letter recently printed in NATURE (p. 77), possess much interest in view of their possible high antiquity. At a meeting of the Geological Society of South Africa on October 30, 1905, Mr. J. P. Johnson, of Johannesburg, in giving an account of a further collection of these implements which he had made during a recent visit to the falls, stated that some of the specimens appear to show the transitional stage between the Eolithic and Palæolithic cultures. In the same paper the occurrence of implements of the "pygmy" type near Bulawayo is recorded.

IN the second part of the *Bergen's Museums Aarbog* for 1905, Mr. P. Bjerkan describes the ascidians collected by the Norwegian fishery-steamer *Michael Sars* from 1900 to 1904, while Mr. H. Brock does the same for the hydroid polyps obtained during the last two years. Three ascidians regarded as new are named by the former author, one of these representing a new genus; but all the hydroids appear to be identified with previously known forms. The organisation of Cephalodiscus has been recently fully investigated by Dr. H. Schepotieff, who records the results of his studies in a third article; while Mr. O. Bidenkap supplies a list of Arctic bryozoans.

To the October issue of the *Proceedings of the Philadelphia Academy of Sciences* Dr. J. W. Haishberger contributes two interesting papers on the flora of the Bermudas. In the first of these the general character of the flora, which is evidently of comparatively recent introduction, is discussed, and the different zones described. The second paper, on the other hand, is devoted to an explanation of the origin of the curious "hour-glass-conformation" of the stem of the Bermuda palmetto (*Sabal blackburniana*), long ago described in a letter from Mr. O. A. Reade to Sir Joseph Hooker. The explanation, according to the author, is simplicity itself, the constrictions being caused by unfavourable seasons of excessive drought.

IN a recent issue (vol. xxi., art. 14) of the Bulletin of the American Museum, Prof. H. F. Osborn describes two new generic types of carnivorous dinosaurs from the

Laramie Cretaceous, namely, *Tyrannosaurus rex* and *Dynamosaurus imperiosus*. The former appears to have been unprovided with armour, and is estimated to have measured 39 feet in length; it walked on the hind-limbs only, with the top of the skull raised about 19 feet from the ground. On the other hand, Dynamosaurus was an armoured type with about a dozen lower teeth, and a number of curious prominences on the inner margin of the jaw. In this comparatively small number of teeth it seems to differ from Leidy's Dinodon, in which some of the teeth were serrated. A third type, *Albertosaurus sarcophagus*, is based on a skull from Albert province, Canada. It is apparently more specialised than Dinodon in the reduction of the truncated anterior teeth, and more primitive than Dynamosaurus in the possession of a larger number of teeth, which are of a less specialised type.

We have received four numbers (inclusive of one devoted to the record of last year's meetings) of the fourteenth volume of the *Transactions of the Academy of St. Louis*. In the bulkiest of these, comprising no less than 248 pages, Mr. T. L. Casey revises the American representatives of that section of the staphylinid or short-clytraed beetles known as the Pœderini, the memoir being, of course, interesting only to specialists. In a second paper Mr. S. Weller describes, under the name of Paraphorhynchus, a new genus of rhynchonella-like brachiopods from the Kinderhook formation of the Mississippi. In a third paper the fresh-water molluscan fauna of McGregor, Iowa, forms the subject. Mr. F. C. Baker communicates some interesting information with regard to the pearl-fishery of that district. The unios are fished up by means of a dredge armed with four-pronged "crowfoot" hooks, and it is believed that malformed specimens are more likely to contain pearls than those with normal shells. These "crippled" mussels, or "clams," are believed by the writer to owe their injuries to the action of the dredge itself.

The last published number of *Biometrika* contains an important paper by Mr. A. O. Powys on fertility, duration of life and reproductive selection in man, with their mutual relations. Several of his results, which are derived from the statistical data of New South Wales, are of high interest. He finds that women with families of five or six children have a better expectation of life after forty-five than mothers of either a larger or smaller number of offspring. The married have a similar advantage over the single. Another conclusion drawn by Mr. Powys from his figures is that "up to the present there is but little Malthusian restraint upon the population in New South Wales what little there may be apparently being confined to the professional, domestic and commercial classes." He confirms Prof. Karl Pearson's view that society is at present being recruited from below—mainly from the artisan class. A useful craniological contribution to the study of inter-racial correlation in man is furnished by E. Tschepourkowsky, of Moscow, and Mr. E. H. J. Schuster publishes the first instalment of a catalogue of the fine collection of skulls in the Oxford Museum, on the basis of a manuscript catalogue prepared some years ago by Dr. Hatchett Jackson. Dr. Brownlee puts the facts of the immunity against small-pox conferred by vaccination and re-vaccination on a firm statistical basis, and Mr. John Blakeman supplies probable error tests of the significance or otherwise of the difference between correlation ratio and coefficient, and consequently of the existence or non-existence in a given population of true linear regression. Mr. Latter deals with the measurements of 1572 specimens of cuckoos' eggs. These, he considers, tend to confirm Prof. Newton's suggestion that there are certain subraces of cuckoos which "in the main confine their attentions, generation after generation, each to its own particular variety of foster-parent." In the "Miscellanea," Mr. W. Palin Elderton proposes new methods for the calculation and adjustment of moments.

Mr. J. H. Hart, the superintendent of the Royal Botanic Gardens, Trinidad, records the discovery of a water-plant, probably a species of Nitella, in the Pitch Lake La Brea, which produces peculiar pear-shaped organs on the stems. These are hollow, and have large openings into the interior, fringed with simple or branched hairs, and within some of them mosquito larvæ were observed, apparently caught and killed by the plant. The suggestion, therefore, is made that the plant might be useful for mosquito destruction.

The use of copper sulphate in the purification of water supplies has from time to time been referred to in these columns. Dr. Howard Jones, the medical officer of health for Newport, Mon., reports the successful employment of the method at Newport. Copper sulphate, to the extent of 1 lb. per million gallons, proved efficient in removing an objectionable fishy odour and rendering the water of the reservoirs bright and clear (*Water*, December 15, 1905).

At a meeting of the Royal Statistical Society on December 19, 1905, Drs. Newsholme and Stevenson read an important paper on the decline of human fertility in the United Kingdom and other countries as shown by corrected birth-rates. They pointed out that corrected birth-rates measure the tendency of communities to increase by natural means, *i.e.* by the excess of births over deaths, or, in other words, their fertility, just as corrected death-rates measure the tendency to decrease. The ordinary "crude" birth-rate is deceptive, since it fails to make allowance for the fact that some populations include a much larger proportion than others of wives at reproductive ages, and for the further fact that the potential fertility of women steadily decreases during the reproductive period until its end is reached. The necessity for correction was illustrated by numerous examples. Thus the crude birth-rate of Ireland in 1903, 23·1, is little higher than that of France in 1902, which was 21·7; but the French birth-rate is practically unaltered by correction, whereas that of Ireland is increased to no less than 36·1. This remarkable result is due to the fact that, although both countries have approximately the same proportion of women aged fifteen to forty-five in their populations, 52·5 per cent. of these in France are married as against 32·5 per cent. in Ireland. Of the countries studied, Ireland alone shows an increase of fertility (3 per cent.) during the last twenty-two years. The conclusion arrived at is that the decline in the birth-rate is associated with a general raising of the standard of comfort, and is an expression of the determination of the people to secure this greater comfort; and the authors anticipate as a result a deterioration of the moral, if not also of the physical, nature of mankind.

Ciel et Terre for November 15, 1905, contains a useful summary of an elaborate discussion by M. A. Angot on the temperature of France and adjoining countries. The original paper appeared in a recent number of *Annales de Geographie*; it deals chiefly with the temperature of France, to which the following remarks entirely refer. As regards the annual means, the isotherms in the north of the country show a decided inclination from north-west to south-east; this is due to the fact that, generally speak-

ing, the land is colder than the sea above lat. 45°, and warmer to the south of that latitude. The lowest mean value is found between Lille and Dunkirk, being about 40° F.; the maximum is on the coast of Nice, and is slightly above 50°. Except on part of the coast of Brittany, the whole of France lies in the zone of moderate climates, in which the annual amplitude is between 50° and 68°. The lowest minima are found in the east; in the winter of 1879–80, temperatures of −22° were recorded. Contrary to current opinion, the highest minima are not on the coast of Nice, where occasionally the cold is very severe, but on the south-west of Brittany and at Ushant, where frost is extremely rare. In the latter regions the absolute maxima are not so high as in other parts. At Ushant a reading of 86° has not been recorded. The highest maxima are found near the Mediterranean, between Carcassonne and Avignon. At Montpellier, a temperature of 109° was recorded on July 19, 1904; this is the highest reading known in France. The details of the discussion are being published in the *Annales* of the French Central Meteorological Office.

IN the *Engineering Magazine* for December, 1905, Mr. E. Guarini gives some striking illustrations of the electric railway at Gruyères. The description is typical of much of the work now being done in the construction of electric railways in Switzerland, where the abundant water-power is especially favourable to the development of such enterprises.

IN the *Engineering and Mining Journal* Mr. F. L. Hoffman gives details of the fatal accidents in coal mining in the United States in 1904. The fatal accident rate was 3·38 per thousand workmen employed, as against an average of 3·03 per thousand for the decade 1895–1904. The relative mortality due to fatal accidents continues to be unreasonably high, and the problem of the prevention of such accidents remains the most serious and perplexing in coal-mining operations.

THE paper recently read by Mr. E. M. Speakman on the determination of the principal dimensions of the steam turbine before the Institution of Engineers and Shipbuilders in Scotland, gave rise to a discussion of great interest in which important information was given regarding the application of the steam turbine to marine work. It was pointed out that the trials of the Cunard steamship *Carmania*, the largest turbine steamer yet built, had fulfilled in every way the highest expectations of all connected with the ship.

AT the last meeting of the Institution of Mechanical Engineers a paper on the behaviour of materials of construction under pure shear was read by Mr. E. G. Izod. The results obtained seem to point to the fact that there is no common law connecting the ultimate shearing stress with the ultimate tensile stress. With crystalline materials, such as cast iron or those with very little or no elongation, the former exceeds the latter by as much as 20 per cent. or 25 per cent., while from fibrous material or, more properly speaking, those with a fairly high measure of ductility, the ultimate shear stress may be anything from 0 per cent to 50 per cent. less than the ultimate tensile stress.

THE second part of the report of the Ontario Bureau of Mines for 1905 is devoted to an important monograph on the cobalt-nickel arsenides and silver deposits of Temiskaming by Mr. W. G. Miller. It covers sixty-six pages, and is illustrated by twenty-eight reproductions of photographs and two geological maps. The deposits were discovered in October, 1903, during the construction of the Temiskaming and Northern Ontario Railway. They occupy narrow, practically vertical fissures cutting through a series of unusually slightly inclined metamorphosed fragmental rocks of Lower Huronian age. A few veins have also been found in the adjacent diabase. The chief ores are native silver, smaltite, niccolite, and chloanthite, with which are associated argentite, pyrargyrite, dyscrasite, erythrite, and other comparatively rare minerals. None of the veins are wide, the maximum being about 18 inches. Some that have been traced 100 feet or more average 1 inch in width. The production during the quarter ended June 30 was 537 tons, the average metallic contents being:—silver, 4·158 per cent.; cobalt, 6·89 per cent.; nickel, 3·09 per cent.; and arsenic, 30·91 per cent. An interesting mineral occurrence is a white clay-like material in the weathered parts of the veins. The white colour of this mineral is due to the intermixture of the green nickel arsenate, annabergite, with the pink cobalt bloom, the mineral showing on analysis 29·30 per cent. of nickel oxide, 6·43 per cent. of cobalt oxide, and 38·31 per cent. of arsenic pentoxide. Hitherto New Caledonia has had practically a monopoly of the world's production of cobalt. Worked primarily for silver with their high values in that metal, the Ontario deposits, with nickel and arsenic as by-products, should prove a strong competitor, even if they should not control absolutely the cobalt market.

MESSRS. F. VIEWEG AND SON, Brunswick, have just published the ninth edition of Prof. A. Bernthsen's "Kurzes Lehrbuch der organischen Chemie." The work appeared originally in 1887; and in the preparation of the present edition Dr. E. Mohr is associated with the author.

STUDENTS and others interested in microscopy will be glad to have their attention directed to new lists of microscopic slides and of second-hand instruments and accessories just issued by Messrs. Clarke and Page, Leadenhall Street, E.C. Special mention should be made of the marine and botanical slides, which are fine examples of cutting, staining, and mounting. A series of objectives corrected for photomicrography is also of noteworthy interest.

A LIST of meteorological instruments for observatories and climatological stations has been received from Messrs. Pastorelli and Rapkin, Ltd., Hatton Garden, E.C. Instruments of various forms for the accurate determination of pressure, temperature, rainfall, and other meteorological elements are described and illustrated in the list, which may be consulted with advantage by anyone desiring to equip a station with serviceable apparatus, or to supplement instruments already in use.

MESSRS. EASON AND SON, LTD., of Dublin, have sent us four of their time-saving indexed diaries for 1906. The "Every Hour" diary provides a convenient record of appointments, special business and events, for any hour of any day during the year. The "Cabinet Scribbling" diary is furnished with a double index for rapid reference, the first arranged as a record for such items as addresses and current literature, the second being to the first of each month.

A COPY of "Hazell's Annual" for 1906 has been received. This twenty-first issue maintains the high reputation of its predecessors. To keep in touch with the important foreign events of the year, numerous foreign biographies have been added, and the text of many treaties included. Some sixteen pages are devoted to scientific matters, most of them being given to scientific progress during 1905.

Prominence is also given to higher educational matters, and the man of science will find much in this section to interest him.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have published the twenty-second annual issue, that for 1905, of the "Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland." This useful work of reference is already well known as a trustworthy guide to the scientific societies and their work. Though the volume is very comprehensive, we miss a reference to the Geographical Association and to the Public Schools Science Masters' Association. The editor might consider the advisability of including associations dealing with educational science.

A NEW vernier rule and scale designed by Mr. S. Irwin Crookes has been received from the maker—Mr. W. H. Harling, 47 Finsbury Pavement, E.C. The rule is divided on one face into inches and eighths of an inch and centimetres and millimetres; the other face has on the edges divisions and numbers representing degrees from 0 to 150, and a barometer scale reading from 20 to 32. A metal vernier slides in a slot cut through the middle of the length of the rule, and it is divided in four different ways to read fractions of the four scales on the rule. The device should be valuable in making students familiar with the use of the vernier on many precise scientific instruments.

THE second annual issue of the "Science Year Book" (5s. net), edited by Major B. F. S. Baden-Powell, has been published by Messrs. King, Sell and Olding, Ltd. Several new features have been introduced, and every care appears to have been taken to make the volume serviceable to men of science and others interested in natural knowledge. The year book includes a diary containing at the head of every daily page the astronomical and meteorological particulars of the day likely to be of interest, and blank spaces for recording results of observations. Other characteristics are tables of useful data, an astronomical ephemeris, maps of the constellations, charts of planetary positions during 1906, and various statistics and notes referring to matters not usually included in ordinary calendars and almanacs. There are also short summaries of progress in science during last year, an eclectic bibliographical directory, and a list of scientific books published last year. The year book is thus a convenient and helpful companion for the study, laboratory, or observatory.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY:—

Jan. 4.	4h. 12m. to 5h. 10m.	Moon occults ξ^2 Ceti (mag. 4·3).
,, 4.	15h.	Mercury at greatest elongation, 23° 0′ W.
,, 5.	5h.	Venus in conjunction with Uranus, Venus 0° 6′ N.
,, 5.	14h. 45m. to 15h. 16m.	Moon occults *f* Tauri (mag. 4·3).
,, 6.	14h. 52m. to 15h. 40m.	Moon occults γ Tauri (mag. 3·9).
,, 14.	11h. 1m. to 11h. 58m.	Moon occults σ Leonis (mag. 4·1).
,, 15.	Venus.	Illuminated portion of disc = 0·993. Of Mars = 0·923.
,, 15.	11h. 2m.	Minimum of Algol (β Persei).
,, 18.	7h. 51m.	Minimum of Algol (β Persei).
,, 26.	8h.	Saturn in conjunction with Moon. Saturn 0° 31′ S.
,, 28.	6h. 17m. to 8h. 14m.	Transit of Jupiter's Sat. III.

A FOURTH NEW COMET (1905*e*).—A telegram from the Kiel Centralstelle announces the discovery of another new comet by the Flagstaff observers. This object was discovered, presumably, from the examination of a photograph, by Mr. Lowell, who gives its position on November 29, 1905, at 9h. 27m. (Flagstaff M.T.), as follows:—

R.A. = 22h. 32·2m., dec. = −8° 42′.

The apparent motion of the comet was either in a north-east or a south-west direction, and the photograph showed that the body was accompanied by two tails.

The above position is in the constellation Aquarius, about half-way between ϕ Aquarii and ι Ceti.

NEW ELEMENTS AND EPHEMERIS FOR COMET 1905*c*.—A new set of elements and a daily ephemeris for comet 1905*c* (Giacobini) are given by Herr E. Strömgren in No. 4062 of the *Astronomische Nachrichten*.

These elements, and an extract from the ephemeris, are given below.

T = 1906 Jan. 22·666 (*M.T. Berlin*).

$$\left.\begin{aligned} \omega &= 198^\circ\ 21'{\cdot}67 \\ \Omega &= 91\ \ 55{\cdot}27 \\ i &= 43\ \ 37{\cdot}08 \end{aligned}\right\} 1905{\cdot}0$$

$$\log q = 9{\cdot}34978$$

Ephemeris (12*h. M.T. Berlin*).

1906	α (true) h. m. s.	δ (true)	log γ	log Δ	Brightness
Jan. 5	17 23 54	− 1 35·7	9·7701	0·0425	7·97
,, 7	17 39 28	− 3 53·5	9·7313	0·0425	9·53
,, 9	17 55 31	− 6 15·9	9·6881	0·0441	11·53
,, 11	18 12 10	− 8 42·5	9·6398	0·0473	14·20
,, 13	18 29 33	− 11 12·8	9·5856	0·0520	17·83

The above positions are plotted on the accompanying chart, which shows approximately the apparent positions of the comet among the stars on the dates indicated.

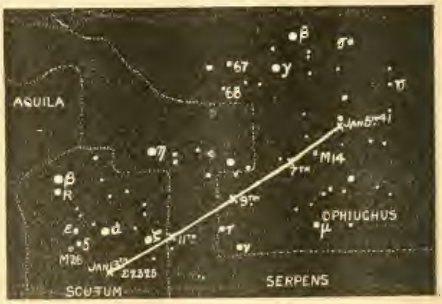


FIG. 1.—Path of Comet 1905*c*, January 5–13, 1906.

THE EXPECTED RETURN OF COMET 1892 V.—In *Circular* No. 84 from the Kiel Centralstelle, M. J. Coniel gives several provisional search-ephemerides, showing positions up to January 6·5, for comet 1892 V.

This comet was discovered by Holmes on November 6, 1892, and was observed during its apparition in 1899, when it passed through its perihelion on April 28. Its period is given by Zwiers as 6·874 years.

MICROMETER MEASURES OF DOUBLE STARS.—The results of a series of micrometer measures of eighty-three double stars, taken from the Struve, Burnham, and Hussey catalogues, are published in No. 4054 of the *Astronomische Nachrichten* by Herr H. E. Lau. The observations were made during March, 1905, with the Urania-Sternwarte (Copenhagen) refractor, of 246 mm. aperture and 4·1 metres focal length, fitted with a Cooke position micrometer.

For each double, the time of observation, the position-angle, the distance, the magnitudes of the components and the power used are given, whilst short comparisons with other measures and notes regarding the probable character and motion are generally added.

FRENCH ASTRONOMICAL "ANNUAIRES."—We have received two French "Annuaires" which are of particular interest to astronomical workers, the one being the "Annuaire du Bureau des Longitudes" (price 1.50 francs), the other the "Annuaire astronomique et météorologique" (price 1.50 francs), which is published by M. Flammarion.

The former volume contains 352 pages devoted to astronomical matters, in addition to which there are three appendices (188 pages) dealing with eclipse observations. In the first of these M. Bigourdan gives a large number of summarised instructions concerning the observations which may be made during eclipses, pointing out the most suitable observations to be undertaken with the instruments readily available. In the second the same writer gives an extremely interesting summary of the observations made in all parts of the shadow-track during the recent eclipse, whilst the third appendix is devoted to a short account, by Prof. Janssen, of his own observations made in Spain on August 30.

M. Flammarion's "Annuaire" will be found to be especially suitable for amateur observers, some interesting phenomenon being given for every day in the year. It contains practically all the data to which the amateur has any need to refer, and the *résumé* of the more important astronomical advances during the past year should prove both interesting and useful.

PRIZES AWARDED AND PROPOSED BY THE PARIS ACADEMY OF SCIENCES.

AT the annual meeting of the academy of December 18, 1905, the president delivered his annual address, and announced the list of prizes awarded in 1905 as follows:—

The Francœur prize is awarded to M. Stouff, for the whole of his mathematical works.

A Montyon prize to M. Mesnager, for his theoretical and experimental work on the theory of elasticity and the resistance of materials. The Poncelet prize to M. Lallemand, for his work on the figure of the earth and for his improvements in geodesic instruments.

The extraordinary prize of 6000 francs has been divided, Colonel Gossot and M. Liouville receiving 4000 francs, for their work on ballistics; M. Carré 1000 francs, for improvements in the navigation of submarines; and M. Merlu 1000 francs, for improvements in the furnaces of marine boilers. The Plumey prize is divided between M. Maurice (2500 francs), for a device for the recuperation of heat in boilers, and M. de Maupeou d'Ableiges (1000 francs), for his investigations of the theory of impact.

The Pierre Guzman prize is not awarded, but M. Perrotin receives 2000 francs from this foundation for the whole of his astronomical work. The Lalande prize is awarded to Prof. W. H. Pickering, for his astronomical work, and especially for his brilliant researches on the satellites of Saturn; the Valz prize to M. Giacobini, for his work on comets; and the G. de Pontecoulant prize to Prof. J. C. Kapteyn, for the whole of his astronomical researches. Of the two memoirs on the theory of comets presented for the Damoiseau prize, that of M. Fayet is adjudged the better, M. Fabry, the author of the second memoir, receiving a prize from the funds of the Guzman prize.

The Gay prize is given to Dr. Cureau, for his accurate geodesic measurements in Africa. The Tchihatchef prize to the late M. Massenet, for geodesic work in Cochin China.

M. Jumau receives the Hébert prize for his book on electric accumulators; M. Georges Urbain the Hughes prize, for his researches on the rare earths; M. Henri Abraham the Gaston Planté prize, for his researches and books; and M. Gouy the La Caze prize, for the whole of his original work.

The Jecker prize is awarded to MM. Sabatier and Senderens, for their researches on the catalytic action of metals; Montyon prizes (unhealthy trades) to M. Donard, for his method of treating slaughter-house refuse, and to M. Carles, for his method of utilising wine residues; the La Caze prize to M. Albert Colson, for the whole of his researches; the Bordin prize to M. Paul Lebeau, for his researches on silicides. The Cahours prize is divided between M. Binet du Jassoneix and M. Kling.

M. G. Friedel receives the Delesse prize for his work in mineralogy; M. Gustave Dollfus the Fontannes prize, for his researches on Tertiary fossils; and M. Marcellin Boule the Alhumbert prize, for his work on the determination of the period of the latest volcanic eruptions in central France.

The grand prize of the physical sciences is awarded to M. Dangeard, for his researches on the development of the egg in the Ascomycetes and Basidiomycetes; the Desmazières prize to M. Ferdinand Renauld, for his memoir on the flora of Madagascar; the Thore prize to M. de Itsvanffi, for his memoirs on the fungi attacking the European vine, the Montagne prize being divided between M. Lutz (1000 francs) and M. Gallaud (500 francs).

In anatomy and zoology, M. C. Gravier receives the Savigny prize.

A Montyon prize is divided between M. L. C. Maillard (the indoxylic colouring matters of human urine), M. Albert Malherbe (researches on sarcoma), and M. Albert Le Play (experimental researches on intestinal poisons). Mentions are accorded to MM. H. Guilleminot, J. Beolt, and Edmond Loison. The Barbier prize is divided between M. J. Dechery and G. Rosenthal, M. Serini receiving a mention. The interest on the funds of the Bréant prize is divided between M. Vincent, M. Martel, and Dr. Remlinger. The Godard prize is accorded to Dr. A. Hogge; the Baron Larrey prize to M. H. Nimier, with very honourable mention to M. Marix; the Bellion prize to Dr. Pressat (malaria and mosquitoes) and MM. Alquier and Drouineau (glycogen and rational nutrition with sugar); the Mège prize to M. Beni-Barde, for his book on hydrotherapeutics; the Serres prize to M. F. Henneguy. The Dusgate prize is not awarded, but M. Onimus receives a very honourable mention.

In physiology the Montyon prize is shared by M. J. Lefèvre and M. J. Laurent. The Philipeaux prize is awarded to M. Victor Henri for his quantitative researches on diastases, M. L. Butte being accorded a mention for his researches on the glycogenic functions of the liver. The Lallemand prize is divided between M. and Mme. Lapicque and M. Jules Voisin, M. Crouzon receiving a very honourable mention. The question set for the Pourat prize was the origin of muscular glycogen. The only paper received on this subject was by M. Maignon, to whom the prize is awarded.

A Montyon prize for statistics is awarded to M. Edmond Gain, with a very honourable mention to M. Jules Fleury.

The Binoux prize is awarded to M. Paul Tannery.

M. Adolph Lieben receives the Lavoisier medal; MM. Senderens, Donard, Lebeau, Jumau, Urbain, Abraham, Gouy, Canovetti, and Leduc the Berthelot medal. The Trémont prize is awarded to M. Ch. Frémont, for his researches in the domain of mechanics; the Gegner prize to M. J. H. Fabre; the Lannelongue prize to Mme. Beclard and Mme. Cusco; the Wilde prize to M. Canovetti and M. Leduc (in equal parts); the Saintour prize to M. Édouard Piette and M. Marchis; the Petit D'Ormoy prize to M. Émile Borel (mathematical sciences) and M. Julien Costantin (natural sciences); the prize founded by Mme. la Marquise de Laplace to M. Fortier; and the Félix Rivot prize to MM. Fortier, Rodhain, Frontard, and Lefranc.

The subjects proposed by the academy for prizes for 1907 are as follows:—

The Francœur prize (1000 francs), for work or discoveries useful to the progress of the science of pure or applied mathematics; the Bordin prize (3000 francs), for the solution of a problem in the theory of algebraic surfaces; the Vaillant prize (4000 francs), for the integration of the equation

$$\frac{\partial^4 u}{\partial x^4} + 2\frac{\partial^4 u}{\partial x^2 \partial y^2} + \frac{\partial^4 u}{\partial y^4} = f(x, y)$$

under specified conditions; and the Poncelet prize (2000 francs), under conditions similar to those of the Francœur prize.

A Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts or sciences.

The extraordinary prize of 6000 francs, for an invention or discovery tending to increase the efficacy of the French naval forces; the Plumey prize (4000 francs), for improvements in the steam engine or any invention contributing to the progress of steam navigation.

The Lalande prize (540 francs), the Valz prize (460 francs), and the G. de Pontécoulant prize (700 francs), for the most interesting observation, memoir, or work in astronomy published during the year.

The Gay prize (1500 francs), for a study of the natural conditions in the Polar regions; the Tchihatchef prize (3000 francs), for exploration in the lesser known portions of Asia.

The Hébert prize (1000 francs), for a treatise or discovery in the practical use of electricity; the Hughes prize (2500 francs), for a discovery contributing to the progress of physics; the Gaston Planté prize (3000 francs), for a French author of a discovery, invention, or important work in electricity; the La Caze prize (10,000 francs), for works or memoirs contributing to the progress of physics; the Kastner-Boursault prize (2000 francs), for the best work on the applications of electricity in the arts, industry, or commerce.

The Jecker prize (10,000 francs), for works useful to the progress of organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists; the Montyon prize (2500 francs and 1500 francs), for the discovery of a process rendering a trade or manufacture less unhealthy.

The grand prize of the physical sciences (3000 francs), for a study of underground water from the hygienic point of view; the Delesse prize (1400 francs), for work in geological or mineralogical science.

The Desmazières prize (1600 francs), for the best work during the year on cryptogams; the Montagne prize (1500 francs), to the French author of the best work on the anatomy, physiology, development, or description of the lower cryptogams; the Thore prize (200 francs), for the best work on the cellular cryptogams of Europe; the de Coincy prize (900 francs); the de la Fons-Mélicocq prize (900 francs), for the best botanical work on the north of France.

The Savigny prize (1300 francs), for the assistance of young travelling zoologists specially occupied with the study of the Egyptian and Syrian invertebrates.

A Montyon prize (2500 francs, mentions 1500 francs), for discoveries useful in the art of healing; the Barbier prize (2000 francs), to the author of a valuable discovery in surgical, medical, pharmaceutical, or botanical science; the Bréant prize (100,000 francs), for the discovery of a radical cure for Asiatic cholera or for pointing out the causes of cholera in such a manner that could lead to its total suppression. Failing these, the interest will be awarded annually for the proof of the existence in the air of substances playing a part in the production or propagation of epidemic disease. The Godard prize (1000 francs), for the best memoir on the anatomy, physiology, or pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for a memoir on military medicine, surgery or hygiene; the Bellion prize (1400 francs), for discoveries profitable to the health of man; the Mège prize (10,000 francs); the Chaussier prize (10,000 francs), for a memoir on legal or practical medicine.

A Montyon prize (750 francs) and the Philipeaux prize (900 francs), for work in experimental physiology; the Lallemand prize (1800 francs), for work on the nervous system; the Pourat prize (1000 francs), for a memoir on the utilisation of pentanes in animal organisms; the La Caze prize (10,000 francs), for a work on physiology.

The Montyon prize (500 francs), for a memoir on French statistics.

The Arago, Lavoisier, and Berthelot medals. The Trémont prize (1100 francs); Gegner prize (3800 francs); the Lannelongue prize (2000 francs); Wilde prize (4000 francs), for memoirs in the subjects of astronomy, physics, chemistry, geology, or experimental mechanics; the Saintour prize (3000 francs); the Petit d'Ormoy prize (two of 10,000 francs), one for pure and applied mathematics, the other for one of the natural sciences; the Leconte prize (50,000 francs); the Pierson-Perrin prize (5000 francs); the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs).

December 31, 1906, will be the last day for sending in memoirs for the above prizes. The prizes bearing the names of Tchihatchef, La Caze, Delesse, Wilde, and Leconte are awarded without preference of nationality.

VOLCANIC ROCKS FROM NEW ZEALAND.[1]

THE district dealt with in this memoir is part of the principal gold-field of New Zealand. The igneous rocks here, which are the source of the gold, are of Tertiary age, though an older series, of Palæozoic age, occurs in the same district. There had been no previous petrographical study of the rocks, of a kind at once comprehensive and detailed, when a specially made collection of 500 specimens was placed in the hands of Prof. Sollas for description, and the report now before us consequently contains much valuable material. Mr. McKay tells us that the principal object of invoking the aid of this well known petrologist was to place the nomenclature of the rocks on a more satisfactory footing. Whatever the object, we are glad to welcome the result, and we also accept gratefully the lavish illustration which attests the liberality of the New Zealand Government. There are upward of 100 plates, reproduced by "process" from photographs, most

FIG. 1.—Hyalopilitic Hypersthene-Andesite; thin slice photographed in polarised light, magnification about 20 diameters.

of them representing thin slices of rocks photographed from the microscope. A figure measuring 7 inches by 5 inches affords a much better conception of the micro-structure of a rock than can be gained from the illustrations in most petrographical memoirs.

The introductory section by Mr. McKay gives a historical account of the district, with bibliographical references, and also sets forth the bearings of Prof. Sollas's results upon the general geology of the district. The Tertiary volcanic rocks are all andesites, dacites, and rhyolites. We may note here a striking contrast with the southern part of New Zealand, where, in the neighbourhood of Dunedin, is found a great variety of phonolites, tinguaites, trachytes, and other types rich in alkalies. The sequence in the Cape Colville district is also of interest. The

[1] "The Rocks of Cape Colville Peninsula, Auckland, New Zealand." By Prof. Sollas, F.R.S. With an Introduction and Descriptive Notes by Alexander McKay, Government Geologist, N.Z. Vol. i. Pp. viii+289; with many plates. (Wellington, 1905.)

Eocene volcanic rocks were mostly andesitic flows and breccias; the Miocene wholly andesitic or dacitic, stratified tuffs with coal; the Pliocene a succession of rhyolitic flows and breccias.

The description by one geologist of specimens collected by another at the Antipodes is a division of labour which has drawbacks as well as advantages. Prof. Sollas, however, has faced the difficulty successfully, and the large amount of labour which he has expended on this study has produced results which have a value by no means confined to New Zealand geology. Arising from the detailed examination of the rocks, there are a number of more general questions of petrographical interest on which the author is able to throw light. One point is the recognition in the ground-mass of the so-called "pilotaxitic" andesites of an interstitial mosaic of quartz, which plays the same part as the glassy base in the "hyalopilitic" type. Another point is the discovery of a certain isotropic hydrated decomposition-product, which partly or wholly replaces the felspar crystals in some of the rhyolites. This was taken by Rutley for glass, and regarded as evidence of the re-fusion of the rock. Our author finds no evidence of devitrification in the glassy rhyolites of this district, but there may be considerable chemical alteration. The Palæozoic dyke-rocks are also described and discussed. They range from quartz-diorite, through "dacite-porphyrite," to dacite, the second being given as a new name to a type of intermediate characters which agrees generally with propylite as defined by Zirkel. We may remark that the term "dacite-porphyry" has been used by American petrologists for a rock not essentially different (see, *e.g.*, Iddings in *Bull.* 150 *U.S. Geol. Sur.* [1898], p. 233).

The report under notice is marked "vol. i.," and we may expect that the geological and petrological study of the Cape Colville district will yield further results of interest. One question which remains to be elucidated is that of the mode of occurrence and origin of the gold. Comparison with the well known Comstock district of Nevada suggests that careful chemical assays of the rocks, both fresh and decomposed, would give significant information on this point.

A. H.

INSECTS AS CARRIERS OF DISEASE.[1]

"Infinite torment of flies."—*Tennyson.*

THE last few years are marked in the annals of medicine by a great increase in our knowledge of certain parasitic diseases, and, above all, in our knowledge of the agency by which the parasites causing the diseases are conveyed.

Chief among these agencies, in carrying the disease-causing organisms from infected to uninfected animals, are the insects, and, amongst the insects, above all the flies. Flies, *e.g.* the common house-fly (*Musca domestica*), can carry about with them the bacillus of anthrax. Flies, ants, and other even more objectionable insects, are not only capable of disseminating the plague-bacillus from man to man, and possibly from rat to man, but they themselves fall victims to the disease, and perish in great numbers. They are active agents in the spread of cholera, and the history of the late war in this country definitely shows that flies play a large part in carrying the bacilli of enteric fever from sources of infection to the food of man, thus spreading the disease.

The diseases already mentioned are caused by bacteria. But flies also play a part in the conveyance of a large number of organisms which are not bacteria, but which, nevertheless, cause disease.

In considering the part played by flies in disseminating diseases not caused by bacteria, we can neglect all but a very few families, those flies which suck blood having alone any interest in this connection.

From the point of view of the physician, by far the most important of these families is the Culicidæ, with more than 300 described species and 5 subfamilies, of which two, the Culicina and the Anophelina, interest us in relation to disease. The gnats or mosquitoes are amongst the most graceful and most beautiful insects that we know; but they have been judged by their works and undoubtedly are unpopular, and we shall see that this unpopularity is well deserved. Gnats belong both to the genus Culex and to the genus Anopheles. The genus Culex, from which the order takes its name, includes not only our commonest gnat, often seen in swarms on summer evenings, but some hundred and thirty other species. Members of this genus convey from man to man the *Filaria nocturna*, one of the causes of the widely-spread disease filariasis. In patients suffering from this disease, minute embryonic round-worms swarm in the blood-vessels of the skin during the hours of darkness. Between six and seven in the evening they begin to appear in the superficial blood-vessels, and they increase in number until midnight, when they may occur in such numbers that five or six hundred may be counted in a single drop of blood. After midnight, the swarms begin to lessen, and, by breakfast time, about eight or nine in the morning, except for a few strayed revellers, they have disappeared from the superficial circulations, and are hidden away in the larger blood-vessels and in the lungs.

In spite of their incredible number, some authorities place it at thirty to forty millions in one man, these minute larval organisms, shaped something like a needle pointed at each end, seem to cause little harm. It might be thought that they would traverse the walls of the blood-vessels, and cause trouble in the surrounding tissues; but this is prevented by a curious device. It is well known that, like insects, round-worms from time to time cast their skins, and the young larvæ in the blood cast theirs, but do not escape from the inside of this winding-sheet; and thus, though they actively wriggle and coil and uncoil their bodies, their progress is as small, and their struggles as little effective, as are those of a man in a strait-waistcoat.

One reason of the normal appearance of the creatures in the blood at night is undoubtedly connected with the habits of its second host, the gnat or mosquito. Two species are accused of carrying the Filaria from man to man—*Culex fatigans* and *Anopheles nigerrimus.* Sucked up with the blood, the round-worms pass into the stomach of the insect. Here they appear to become violently excited, and rush from one end to the other of their enveloping sheath, until they succeed in breaking through it. When free, they pierce the walls of the stomach of the mosquito, and come to rest in the great thoracic muscles. Here the Filarias rest for some two or three weeks, growing considerably and developing a mouth and an alimentary canal, thence, when they are sufficiently developed, they make their way to the proboscis of the mosquito. Here they lie in couples. Exactly how they effect their exit from the mosquito and their entrance into man has not yet been accurately observed; but presumably it is during the process of biting. Once inside man, they work their way to the lymphatics, and very soon the female begins to pour into the lymph a stream of young embryos, which reach the blood-vessels through the thoracic duct. It is, however, the adults which are the source of all the trouble. They are of considerable size, three or four inches in length; and their presence, by blocking the channels of the lymphatics, gives rise to a wide range of disease, of which elephantiasis is the most pronounced form.

We now pass to the second of the diseases carried by gnats, that of Malaria.

The parasite which causes malaria is a much more lowly organised animal than the Filaria. It is named Hæmamœba, and it too is conveyed by an insect, and, so far as we know, by one genus of mosquito only, the Anopheles. Hence from the point of view of malaria it is important to know whether a district is infected with Culex or Anopheles. The former is rather humpbacked and keeps its body parallel with the surface it is biting, and its larva hangs at an angle below the surface of the water by means of a respiratory tube. Anopheles, on the other hand, carries its body at a sharp angle with the surface upon which it rests, and its larva lies flat below the surface-film and parallel with it. The malarial parasite lives in the blood-cells of man, but at a certain period it breaks up into spores which escape into the fluid of the blood, and it is at this moment that the sufferer feels the access of fever. Their presence and growth within the blood-cells

[1] From an Address delivered before the British Association at Pretoria, by A. E. Shipley, F.R.S.

result in the destruction of the latter, a very serious thing to the patient if the organisms be at all numerous. If the spores be sucked up by an Anopheles, they undergo a complex change, and ultimately reproduce an incredible number of minute spores or sporozoites, each capable of infecting man again if it can but win entrance into his body.

In normal circumstances, for each Filaria larva which enters a mosquito one Filaria issues forth, longer, it is true, and more highly developed, but not much changed. The malaria-parasite undergoes, in its passage through the body of the Anopheles, many and varied phases of its life-history. As the Frenchman said of the pork, which goes into one end of the machine in the Chicago meat-factories as live pig, and comes out at the other in the form of sausages, "il est diablement changé en route."

Whoever has watched under a lens the process of "biting," as carried on by a mosquito, must have observed the fleshy proboscis (labium) terminating in a couple of lobes. The labium is grooved like a gutter, and in the groove lie five piercing stylets, and a second groove or labrum. It is along this labrum that the blood is sucked. Between the paired lobes of the labium, and guided by them (as a billiard cue may be guided by two fingers), a bundle of five extremely fine stylets sinks slowly through the epidermis, cutting into the skin as easily as a paper-knife into a soft cheese. Four of these stylets are toothed, but the single median one is shaped like a two-edged sword. Along its centre, where it is thickest, runs an extremely minute groove, only visible under a high power of the microscope. Down this groove flows the saliva, charged with the spores or germs of the malaria-causing parasite. Through this minute groove has flowed the fluid which, it is no exaggeration to say, has changed the face of continents and profoundly affected the fate of nations.

It is an interesting fact that, amongst the Culicidæ, it is the female alone that bites, and she is undoubtedly greedy. If undisturbed, she simply gorges herself until every joint of her chitinous armour is stretched to the cracking point. At times even, like Baron Munchausen's horse after his adventure with the Portcullis, what she takes in at one end runs out at the other. But she never ceases sucking. The great majority of individuals, however, can never taste blood, and subsist mainly on vegetable juices.

Anopheles is often conveyed great distances by the wind, or in railway trains or ships; but of itself it does not fly far, about five or six hundred yards—some authorities place it much lower—is its limit. Both Anopheles and Culex lay their eggs, as is well known, in standing water, and here three out of the four stages in their life-history—the egg, the larva, and the pupa—are passed through. The larva and the pupa hang on to the surface-film of the water by means of certain suspensory hairs, and by their breathing apparatus. Anything which prevents the breathing tubes reaching the air ensures the death of the larva and pupa. Hence the use of paraffin on the pools or breeding places. It, or any other oily fluid, spreads as a thin layer over the surface of the pools and puddles, and clogs the respiratory pores, and the larvæ or pupæ soon die of suffocation.

Thus a considerable degree of success has attended the efforts of the sanitary authorities, largely at the instigation of Major Ross, all over the world, to diminish the mosquito-plague. It is, of course, equally important to try and destroy the parasite in man by means of quinine. This is, however, a matter of very great difficulty. In Africa and in the East nearly all native children are infected with malaria, though they suffer little, and gradually acquire a high degree of immunity. Still, they are always a source of infection; and Europeans living in malarious districts should always place their dwellings to the windward of the native settlements.

Another elegant little gnat, *Stegomyia fasciata*, closely allied to Culex, with which, until recently, it was placed, is the cause of the spread of that most fatal of epidemic diseases, the yellow fever. Like the Culex, but unlike the Anopheles, Stegomyia has a humpbacked outline, and its larva has a long respiratory tube at an angle to its body, from which it hangs suspended from the surface-film of its watery home. It is a very widely distributed creature; it girdles the earth between the tropics, and is said to live well on shipboard. It breeds in almost any standing fresh water, provided it be not brackish. The female is said to be most active during the warmer hours of the day, from noon until three or so, and in some of the West Indies it is known as the "day-mosquito."

The organism which causes yellow fever has yet to be found. It seems that it is not a bacterium, and that it lives in the blood of man. It evidently passes through a definite series of changes in the mosquito, for freshly infected mosquitoes do not at once convey the disease. After biting an infected person it takes twelve days for the unknown organism to develop in the Stegomyia, before it is ready for a change of host. The mosquitoes are then capable of inoculating man with the disease for nearly two months. The period during which a man may infect the mosquito, should it bite him, is far shorter, and extends only over the first three days of the illness.

Very careful search has hitherto failed to reveal the presence of the parasite of yellow fever. By its works alone can it be judged. It seems that, like the germ of rinderpest and of foot-and-mouth disease, it is ultra-microscopic; and our highest lenses fail to resolve it.

King Solomon sent to Tarshish for gold and silver, ivory, and apes and peacocks, and, at the present day, people mostly go to Africa for gold, diamonds, ivory, and game. These are the baits that draw them in. Of the great obstacles, however, which have for generations succeeded in keeping that great continent, except at the fringes, comparatively free from immigrants, three, and these by no means the least important, are insignificant members of the order Diptera. We have considered the case of Culex and Anopheles; the third fly we have now to do with is the tsetse fly (Glossina), which communicates fatal diseases to man and to cattle and domesticated animals of all kinds.

The members of the genus Glossina are unattractive insects, a little larger than our common house-fly, with a sober brownish or brownish-grey coloration. When at rest the two wings are completely superimposed, like the blades of a shut pair of scissors; and this feature readily serves to distinguish the genus from that of all other blood-sucking flies, and is of great use in discriminating between the tsetse and the somewhat nearly allied Stomoxys and Hæmatoputa.

The tsetse flies rapidly and directly to the object it seeks, and must have a keen sense of smell, or sight, or both, making straight for its prey, and being most persistent in its attacks. The buzzing which it produces when flying is peculiar, and easily recognised again when once heard. After feeding, the fly emits a higher note, a fact recalling the observation of Dr. Nuttall and the present writer on the note of Anopheles, in which animal we observed that "the larger the meal the higher the note." The tsetse does not settle lightly and imperceptibly on the sufferer as the Culicidæ do, nor does it alight slowly and circumspectly after the manner of the horse-flies, but it comes down with a bump, square on its legs. Like the mosquito, the tsetse is greedy, and sucks voraciously. The abdomen becomes almost spherical, and of a crimson red, and in the course of a few seconds the fly has exchanged the meagre proportions of a Don Quixote for the ampler circumference of a Sancho Panza. Unlike so many of the blood-sucking Diptera, in which the habit is confined to the females, both sexes of Glossina attack warm-blooded creatures.

The fly always seems to choose a very inaccessible portion of the body to operate on, between the shoulders in man, or on the back and belly in cattle and horses, even inside the nostrils in the latter, or on the forehead in dogs. According to Lieut.-Colonel D. Bruce, R.A.M.C., to whom we owe so much of our knowledge of this fly and its evil work, the female does not lay eggs, but is viviparous, and produces a large active yellow larva, which immediately crawls away to some secluded crevice, and straightway turns into a hard, black pupa, from which the imago emerges in some six weeks. Thus two stages, the egg and the larva, both peculiarly liable to destruction, are practically skipped in the tsetse, at any rate in some species.

The genera of the Culicidæ which we have considered are found practically all over the world, but the genus

Glossina is fortunately confined to Africa. From the admirable map of the geographical distribution of the fly compiled by Mr. Austen, we gather that its northern limit corresponds with a line drawn from the Gambia, through Lake Chad to Somaliland, somewhere about the thirteenth parallel of north latitude. Its southern limit is about on a level with the northern limit of Zululand. The tsetse, of course, is not found everywhere within this area; and, though it has probably escaped observation in many districts, it seems clear that it is very sporadically distributed.

Even where the tsetse is found, it is not uniformly distributed, but occurs in certain localities only. These form the much dreaded "fly-belts." The normal prey of the fly is undoubtedly the big game of Africa. But they are not the only factor in its distribution. The nature of the land also plays a part. There are the usual discrepancies in the accounts of travellers, especially of African travellers, as to the exact localities the Glossina affects; but most writers agree that the tsetse is not found in the open veldt. It must have cover. Warm, moist, steamy hollows, containing water and clothed with forest growth, are the haunts chosen.

The tsetse fly belongs to the family Muscidæ, the true flies, a very large family, which also includes our house-fly, blue-bottle fly, &c. These flies, unlike Anopheles and Culex, are day-flies, and begin to disappear at or about sunset, a fact noted centuries ago by Dante:—

> "Nel tempo che colui, che il mondo schiara,
> La faccia sua a noi tien meno ascosa,
> Come la mosca cede alla zanzara."[1]

The practical disappearance as the temperature drops has enabled the South African traveller to traverse the fly-belts with impunity during the cooler hours of the night. At nightfall the tsetse seems to retire to rest amongst the shrubs and undergrowth; but, if the weather be warm, it may sit up late; and some experienced travellers refrain from entering a fly-belt, especially on a summer's night, until the temperature has considerably fallen.

The sickness and death of the cattle bitten by the tsetse were formerly attributed to some specific poison secreted by the fly, and injected during the process of biting. It is now, largely owing to the researches of Colonel Bruce, known to be due to the inoculation of the beasts with a minute parasitic organism conveyed from host to host by the fly. The disease is known as "nagana," and the organism that causes it is a species of Trypanosoma, a flagellate protozoon or unicellular organism, which moves by means of the lashing of a minute, whip-like process. Since Bruce's researches, a number of Trypanosomas have been found causing disease in various parts of the world; thus *T. evansii* causes the surra disease of cattle, horses, and camels in India; *T. equinum* produces the "mal de caderas" of the horse ranches of South America; and *T. equiperdum* is responsible for the North African disease called by the French the dourine; *T. theileri* causes the gall-sickness, and there are others. The particular species of Trypanosoma which causes nagana is *Trypanosoma brucei*, and it does not attack man; goats and donkeys seem also immune; but, with these exceptions, all domesticated animals suffer, and in a great percentage of cases the disease terminates in death. Just as the native children in Africa form the source of the supply of the malarial parasite without appearing to suffer much, so do the big game of the country abound in Trypanosoma without appearing to be any the worse. They are in Lankester's phrase "tolerant" of the parasite, and a harmony between them and the parasite has been established, so that both live together without hurting one another. It is from the big game that the disease has spread. In their bodies the harmful effect of the parasite has, through countless generations, become attenuated; but it leaps into full activity again as soon as the Trypanosoma wins its way into the body of any introduced cattle, horse, or domesticated animal.

The report of Colonel Bruce, which has just been issued, shows that the sleeping sickness which devastates Central Africa, from the west coast to the east, is also conveyed by a species of tsetse fly. Writing more than a hundred years ago of Sierra Leone, Winterbottom mentions the disease. "The Africans," he says, "are very subject to a species of lethargy which they are very much afraid of, as it proves fatal in every instance." Early last century it was recorded in Brazil and the West Indies; and Lankester has suggested that the deaths which our slave-owning ancestors used to attribute to a severe form of home-sickness, or even to a broken heart, were in reality caused by sleeping sickness. In one year the deaths in the region of Busoga reached a total of 20,000; and it is calculated that although the disease was only noticed in Uganda for the first time in 1901, by the middle of 1904 100,000 people had been killed by it. The disease is caused by the presence of a second species of Trypanosoma in the blood and in the cerebro-spinal fluid. The existence of this parasite has now been proved in all the cases recently investigated. Apparently the Trypanosoma can live in the blood without doing much harm, and only when it reaches the cerebro-spinal canal does it set up the sleeping-sickness. It is also found in great numbers in the lymphatic glands, especially those of the neck, which in patients infected by the parasite are usually swollen and tender. From the similarity of the parasite to that causing the cattle disease of South Africa, the idea at once arose that the Trypanosoma was conveyed from man to man by a biting insect. Along the lake shores a species of tsetse (*G. palpalis*) abounds; and it was noticed that if the fly, having fed off a sleeping-sickness patient, bit a monkey, the monkey became infected. Further, flies which were captured in a sleeping-sickness district were also capable of conveying the disease to healthy monkeys. The proof that sleeping sickness is due to a Trypanosoma known as *T. gambiense* present in the cerebro-spinal fluid of the patient, due to the brilliant research of Colonel Bruce and his colleagues, Captain Grieg and Dr. Nabarro, and that it is conveyed from man to man by *Glossina palpalis*, seems now complete.

Finally, we come to a last class of diseases which is of the utmost interest to the agriculturist and settler, and yet at present is but little understood. These diseases are caused by various species of a protozoon named Piroplasma, and the diseases may collectively be spoken of as piroplasmosis. When they are present in cattle they are spoken of in various parts of the world as Texas fever, tick-fever, blackwater, and redwater. Heartwater in sheep is a form of piroplasmosis. Horses also suffer, and the malignant jaundice or bilious fever which makes it impossible to keep dogs in certain parts of this country is also caused by a Piroplasma. Finally, under the name of Rocky Mountain fever, spotted- or tick-fever, the disease attacks man throughout the west half of the United States.

The organisms which cause the disease live for the most part in the red blood corpuscles, but they are sometimes to be found in the plasma or liquid of the blood. Unfortunately we know comparatively little about the life-history of the Piroplasma or of the various stages it passes through, but we do know how it is transmitted from animal to animal and from man to man.

We have seen that the carrier or "go-between" in the case of the malaria is the mosquito, and in the case of the sleeping sickness is the tsetse fly. Piroplasma, however, is not conveyed from host to host by any insect, but by mites or ticks, members of the large group of Acarines, which include beside the mites the spiders, scorpions, harvestmen, and many others.

The ticks differ from the insect bearers of disease, inasmuch as the tick that attacks an ox or a dog does not itself convey the disease, but it lays eggs—for I regret to say here, as with the Anopheles, it is the female only that bites—and from these eggs arises the generation which is infective, and which is capable of spreading the disease. The tick which conveys the Piroplasma from dog to dog is called *Haemophysalis leachi*. The brilliant researches of Mr. Lounsbury have shown that even the young are not immediately capable of giving rise to the disease. The female tick gorges herself with blood, drops to the ground, and begins laying eggs. From these eggs small six-legged larvæ emerge. These larvæ, if they get a chance, attach themselves to a dog, gorge themselves, and after a couple of days fall off. If their mother was infected they nevertheless do not convey the parasite. After lying for a time upon the ground the larval tick casts its skin and becomes

[1] *Inf.* xxvi. 26–28.

a nymph, a stage roughly corresponding with chrysalis of a butterfly. This nymph, if it has luck, again attaches itself to the dog and has a meal, but it also fails to infect the dog. After a varying time it also drops to the ground, undergoes a metamorphosis, and gives rise to the eight-legged adult tick. Here at last we reach the infective stage; the adult tick is alone capable of giving the disease to the animal upon which she feeds, and then only when she is descended from a tick which has bitten an infested host. Think what a life-history this parasite has! Living in the blood-corpuscles of a dog, sucked up by an adult tick, passed through her body until it reaches an egg, laid with that egg, being present while the egg segments and slowly develops into the larva; living quiescent during the larval stage and the nymph stage, surviving the metamorphosis, and only leaping into activity when the adult stage is reached. This most remarkable story probably indicates that the Piroplasma undergoes a series of changes comparable to those of the malaria organism when it is inside the mosquito; what these stages are we do not at present know, but Dr. Nuttall and Mr. Smedley at Cambridge, and many other observers elsewhere, are at work on the problem, and soon we shall have more light.

With regard to bovine piroplasmosis, Koch and others have distinguished redwater fever, which is conveyed by *Rhipicephalus annulatus*, and in Europe probably by *Ixodes reduvius* from the Rhodesian fever which is conveyed by *Rhipicephalus appendiculatus*, and I regret to say by a species dedicated to myself, *Rhipicephalus shipleyi*.[1]

The heartwater disease of sheep and goats is similarly conveyed by *Amblyomma hebraeum*, the Bont tick, and many farmers accuse *Ixodes pilosus* of causing the well known paralysis from which sheep suffer in the early autumn; and there are many others, diseases such as the chicken disease of Brazil, which is so fatal to poultry yards, and which is conveyed by the *Argas persicus*.

I will not weary you with more diseases. I think I have said enough to show that within the last few years a flood of light has been thrown upon diseases, not only of man and his domestic animals, but upon such insignificant creatures as the mosquito and the tick. I have tried to show how these diseases interact, and how both hosts are absolutely essential to the disease. We can now to a great extent control these troubles; the old idea that there is something unhealthy in the climate of the tropics is giving way to the idea that the unhealthiness is due to definite organisms conveyed into man by definite biting insects. We have at last, I think, an explanation of why Beelzebub was called the Lord of Flies.

[1] This happily turns out to be a synonym.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Prof. Osler has been nominated by the Vice-Chancellor and Proctors as a delegate of the University Press.

A decree has been approved by Convocation providing that the stipend of the Sibthorpian professor of rural economy shall be 600*l.* a year, independently of the income from the Sibthorpian estate, in the years 1906 and 1907. This is necessary if an election is to be made before 1908, as the full endowment will not be provided by St. John's College until that year. St. John's is to nominate a member of the board of electors to the chair.

The following elections have been made to scholarships and exhibitions in natural science:—Balliol College, to a Brakenbury scholarship, J. S. Huxley (Eton College), to a scholarship, C. Whitley (Bromsgrove School); Lincoln College, to a scholarship, P. Pickford (Exeter School), to an exhibition, E. Hancock (Exeter School); Magdalen College, to a demyship, D. L. Hammick (Whitgift Grammar School, Croydon), to an exhibition, J. F. Venables (Magdalen College School, Oxford); Christ Church, to a scholarship, J. T. Lattey (Dulwich College), to an exhibition, W. A. Akers (Aldenham School); Trinity College, to a Millard scholarship, H. G. J. Moseley (Eton College).

A COURSE of lectures upon modern research in the psychology of memory, accompanied by the exhibition of apparatus, will be given by Dr. C. S. Myers in the physiological theatre of King's College, London, on January 12 and the following seven Fridays at 6 p.m. The course is free to internal students of the university and to all teachers. The general course in experimental psychology, accompanied by laboratory work, will be held on Saturdays, beginning on January 13. Particulars may be obtained from the secretary of the college.

THE *London University Gazette* announces that a course of nine or ten lectures on the origin of Gymnosperms will be given during the Lent term by Prof. F. W. Oliver, F.R.S., at University College on Mondays, commencing on January 22. There is no fee for the lectures. Further details and cards of admission may be obtained on application to the academic registrar at the university. Two courses of lectures have been arranged for the Lent term in the physiological laboratory of the university, viz. eight lectures on tissue-respiration by Mr. J. Barcroft on Tuesdays, beginning on January 16, and eight lectures on respiration by Dr. M. S. Pembrey on Fridays, beginning on January 19.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23, 1905.—"Some Observations on *Welwitschia mirabilis*, Hooker, f. By Prof. H. H. W. **Pearson.** Communicated by A. C. Seward, F.R.S.

Evidence is adduced in support of the view that Welwitschia is partially, if not entirely, insect-pollinated, and that the processes of fertilisation and maturation of the seed seem to be effected much more rapidly than in other Gymnosperms.

The author supports Strasburger's view that the male flowers are reduced forms of an originally hermaphrodite structure. The nature of the prothallial tubes is discussed, and the conclusion is that the true interpretation of the extraordinary behaviour of the fertile end of the Welwitschia prothallus will be founded upon a comparison with the corresponding portion of the embryo-sac of *Gnetum gnemon*.

December 14, 1905.—"The Araucarieæ, Recent and Extinct." By A. C. **Seward,** F.R.S., and Sibille O. **Ford.**

The work was undertaken primarily with a view to ascertain whether the genera Agathis and Araucaria exhibit any of those features which are often associated with survivals from the past; the aim was to obtain an answer to the question: Do the existing Araucarieæ afford evidence of primitive characters or do they throw light on the phylogeny of the araucarian phylum?

A comparison is made between the Araucarieæ and Lycopodiales; arguments are advanced in favour of the view that this group of Gymnosperms, unlike the Cycadales, was probably derived from lycopodiaceous ancestors. Attention is directed to the various characters in which the Araucarieæ differ from other members of the Coniferales, and the advisability is suggested of giving more definite expression to their somewhat isolated position by substituting the designation Araucariales for Araucarieæ.

The authors contend that the general consent which has deservedly been given to the view that the Cycadales and Filicales are intimately connected by descent may have the effect of inducing an attitude too prone to overestimate the value of the arguments advanced in support of an extension of the idea of a filicinean ancestry to other sections of the Gymnosperms.

"On the Microsporangia of the Pteridosperms." By R. **Kidston,** F.R.S.

The conclusion arrived at is that the Cycadofilices, which long antedated the advent of true ferns, cannot have been derived from them, but are themselves the oldest type of fern-like plant at present known. In regard to the true ferns, it seems probable that they may have been derived from the Botryopterideæ.

"The Mammalian Cerebral Cortex, with Special Reference to its Comparative Histology. I., Order Insectivora." By Dr. G. A. **Watson.** Communicated by Dr. F. W. Mott, F.R.S.

This paper is one of a series in which it is hoped to deal with the cerebral cortex of the various orders of mammals so far as material is available, the primary object of the research being to endeavour to shed some further light upon the significance of the mammalian neopallial lamination. In this natural order the brains of the mole (*Talpa europea*), shrew (*Sorex vulgaris*), and hedgehog (*Erinaceus europeus*) have been exhaustively studied.

The neopallium of these animals has been mapped out into various areas, which on the dorso-lateral and mesial aspects appear to present (1) "motor," (2) general sensory, and (3) undifferentiated or unspecialised characteristics, the two former being in every way the best developed neopallial regions. On the postero-mesial aspect a field has been delimited which possesses sensory features; a portion of this is unspecialised, and the remainder is believed to represent the cortical distribution of the optic and fifth sensory nerves respectively. Certain differences in the extent and state of development of these various areas occur in the several animals, and these agree with certain differences in their habits.

The total depth of the cortex in the best developed regions differs in the three animals, yet the relative depth of the separate layers is about the same in all. Micrometric measurements of the cortex of the mole have been made by Dr. Bolton, and these have been compared with the latter's measurements of the cortical layers in the developing human fœtus and the normal human adult. Dividing the cortex into the portions above and below the granular layer, it is found that the increase in depth of the human cortex as compared with that, say, of the mole is *very* largely due to increase in the "*supra-granular*" (*i.e.* the true pyramidal) layer.

The conclusions as to the functional significance of the neopallial primary cell layers in the Insectivora and in mammals belonging to other natural orders so far examined form a complement to those advanced by Bolton. The "*infra-granular*" layer (iv. and v.), omitting the constituent cells which possess motor or analogous functions, is concerned especially with the associations necessary for the performance of the instinctive activities, the "supra-granular" (ii.) with the higher associations ("intelligence"), the capacity for which is shown by the educability of the animal. In practical animal behaviour the two sets of processes are probably more or less constantly interwoven, the higher activities (supra-granular layer) coming to the aid of the lower so far as the capability of the animal allows. In the case of lower mammals, *e.g.* Insectivora, the limits of this capability are comparatively soon reached, and correspondingly these mammals possess a relatively poor "supra-granular" layer.

Anthropological Institute, December 19, 1905.—Prof. W. Gowland, president, in the chair.—The origin of Eolithic flints from natural causes: S. H. **Warren**. Mr. Warren classified eoliths as follows:—(1) Flints with battered surfaces formed by prolonged concussions; (2) flints with flaked surfaces formed by sharp percussions; (3) flints with chipped edges formed by (*a*) indiscriminate battering, (*b*) perpendicular pressure. The possible causes of the production of eoliths were considered by Mr. Warren to be:—(*a*) human agency; (*b*) wave action; (*c*) water abrasion by streams, rivers, floods; (*d*) soil abrasion by the pressure and movement of soil creep and foundering; (*e*) the drag of ice; and (*f*) wear and tear on the surface of the ground. The eoliths of the first class, as defined above, may obviously be due to water abrasion. Those of the second class bear evidences of percussion-flaking, acting along the lines of least resistance, but show no control-working upon a definite design. It is concluded that these forms, together with those having indiscriminately battered edges, are likewise due to water abrasion. It is noteworthy that these classes are characteristic of river gravels of various ages, and may be reproduced by artificial rolling. The flints with definitely pressure-chipped edges include the typical "plateau implements" of Sir J. Prestwich. The chief forms are a general chipped edge, and the notch, either single or in various combinations, such as the double notch with intervening point. It is found by experiment that these are the forms produced by the fortuitous pressure of one flint against another. The angle of chipping and the type of the fractures are also identical in the case of the experimental productions and the plateau flints. These pressure-chipped eoliths are characteristic of hill-drifts which have suffered from the movement of soil-creep and foundering, and it is concluded that this is the cause of the chipped edges. This process is named "soil abrasion" in contradistinction to water abrasion. Collateral evidence of these differential soil movements under pressure is furnished by the frequent association with the eoliths of the hill-drifts of flints with surfaces striated in all directions. Subsidiary causes of the pressure-chipped eoliths, or those which have operated in certain special cases, are the drag of ice and wear and tear on the surface of the ground, including the impact of the hoofs of animals.

EDINBURGH.

Royal Society, December 4, 1905.—Lord Kelvin, president, in the chair.—The development of the skull and visceral arches in Lepidosiren: W. E. **Agar**. The material for this investigation had been collected by Prof. Graham Kerr in the Chaco, and by the late Mr. J. S. Budgett in the Gambia. The chief points established were as follows:—The development of the notochord underwent a curious modification, the front end disintegrating at an early stage and being replaced by a forward growth of the remaining part of the chorda. The quadrate was from the first continuous with the trabecula, and there was no hyomandibular. A vestigial palato-pterygoid bar was present. The general development of the skull resembled the process in the Urodeles, especially as regards the occipital region and nasal capsules. There were two pairs of upper labial cartilages. In the change from the larval to the adult form there was no absorption of cartilage, but the chondrocranium showed a steady increase in completeness.—Perturbations in longitude of Neptune by the hypothetical planet: Prof. George **Forbes**, F.R.S. About twenty-five years ago the author had deduced evidence from the distribution of the aphelia of cometary orbits that there existed a planet of considerable mass beyond the orbit of Neptune, and the existence of such a planet was now generally accepted by astronomers. In the present paper, by means of calculations based upon certain assumptions as to position and mass of the hypothetical planet, Prof. Forbes discussed the growing discrepancies between the observed longitudes of Neptune and those assigned by the theories both of Leverrier and Newcomb. The present configuration of the two planets was not the best to bring out clearly the nature of the perturbation, but he thought that in ten years sufficient material would be in hand to enable us to make a serious effort to fix the position of the ultra-Neptunian planet. Exhibition of two lantern slides of zoological interest: Prof. D. J. **Cunningham**, F.R.S. The one showed a group of monkeys in the Dublin Zoological Gardens sitting in newly fallen snow without the least discomfort; from the beginning of their captivity they had lived in the open air. The other showed a young marmoset clinging in its peculiar fashion to the back of a white rabbit which had acted as foster-mother from the start of the marmoset's individual life.

December 18, 1905.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—Library aids to mathematical research: Dr. Thomas **Muir**, F.R.S. After a critical discussion of the various bibliographical aids to the mathematical student, the author proceeded to point out the shortcomings in the equipment of the most important scientific libraries in Edinburgh and Glasgow. Out of sixty-seven important mathematical serials, only thirty-four were to be found in Edinburgh and Glasgow; and of the thirty-one to be found in Edinburgh, twenty-one were duplicated in the university and Royal Society libraries. Dr. Muir hoped that by some system of cooperation between the Edinburgh libraries, or even between Edinburgh and Glasgow, every mathematical serial published in Europe and America would be made available to mathematical workers. At present historical research was absolutely debarred.—Preliminary note regarding an experimental investigation into the effects of varying diets upon growth and nutrition: Dr. Chalmers **Watson**. The experiments consisted in feeding colonies of rats upon various diets, namely, (1) skim milk and bread; (2) rice;

(3) porridge; (4) horse flesh; (5) ox flesh. Interesting details were given and illustrated by diagrams and tables. The rats were found to thrive best on the skim milk and bread. Rice, because of its lack of proteid qualities, stunted the growth. Porridge was inferior to the skim milk and bread, while horse flesh and ox flesh were positively deleterious, being fatal to young rats. Moreover, the mortality among the young was greatly increased when the adult parents were fed on flesh. Experiments were also tried on the effects of change of diet. For example, after the young rats had been reduced almost to starvation point by a flesh diet, they were put on milk and bread, and immediately began to recover, and rapidly reached the maximum growth. In this set of experiments it was found that sweet milk and bread were inferior as a recuperative diet to skim milk and bread. Prof. Schäfer, in whose laboratory the experiments had been carried out, referred to the importance of the research in relation to physical deterioration. Although it would be absurd to apply the results directly to the question of human diets and nutrition, there was no doubt that the physical deterioration so much spoken about was due, not only to underfeeding, but to wrong feeding. So far as the public was concerned, the moral was that we must feed our children correctly.

NEW SOUTH WALES.

Royal Society, October 4, 1905.—Mr. H. A. Lenehan, president, in the chair.—Note on some simple models for use in the teaching of elementary crystallography: Dr. W. G. **Woolnough**. The models illustrated the connection between the number of faces in a crystal "form" and the elements of symmetry of the group to which the crystal belongs. Planes of symmetry are represented in the models by mirrors suitably arranged, and crystal faces by triangles of cardboard. The mirrors are so fixed that the multiple reflection of the card reproduces the shape of the most general form possible in the crystal group.

November 1, 1905.—Mr. H. A. Lenehan, president, in the chair.—Provisional determination of astronomical refraction, from observations made with the meridian circle instrument of the Sydney Observatory: C. J. **Merfield**. This paper gives the results of an investigation into astronomical refraction, deduced from some five hundred and fifty observations of forty fundamental stars taken with the meridian circle of the Sydney Observatory during the month of July, 1905. The conclusions arrived at by the author are as follows:—That if observations of zenith distance of celestial objects are taken between limits of time separated by some hours, then greater accuracy in the reductions, to obtain correct positions, can be obtained by taking fully into consideration the fluctuations of the height of the barometer, and especially the variation of the temperature, indicated by the readings of the thermometer, when computing the refractions for a series of observations extending over a period of several hours' duration. Adopting a state of the atmosphere for a mean of the times of observation does not seem sufficient. Further, the refraction table (Bessel) in use at the Sydney Observatory would represent the observed refractions much better if a correction be applied for the difference in the force of gravity at Greenwich and Sydney. This correction is represented by a very simple equation which is a function of the latitudes of the two places. The author also considers that the refractions computed from the Pulkowa tables, after applying the gravity correction, would represent the observed values better than those of Bessel.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 4.

RONTGEN SOCIETY, at 8.15.—Presidential address: The Present Position of Radio-activity: Prof. F. Soddy.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Present Position of the Sewage Question: J. F. Reade.

FRIDAY, JANUARY 5.

GEOLOGISTS' ASSOCIATION, at 8.—On the Geology of the Country around the Sogne Fjord and the Hardanger Fjord, Norway: H. W. Monckton.

MONDAY, JANUARY 8.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Cinchona Barks and their Cultivation: D. Howard.—A New Method for the Quantitative Estimation of Acetone: S. J. M. Auld.

TUESDAY, JANUARY 9.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Elimination of Stormwater from Sewerage Systems: D. E. Lloyd-Davies.—On the Elimination of Suspended Solids and Colloidal Matters from Sewage: Lieut.-Colonel A. S. Jones and Dr. W. O. Travis.

WEDNESDAY, JANUARY 10.

GEOLOGICAL SOCIETY, at 8.—The Clay-with-Flints: its Origin and Distribution: A. J. Jukes-Browne.—On Footprints from the Permian of Mansfield (Nottinghamshire): G. Hickling.

THURSDAY, JANUARY 11.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell (*Conclusion of Discussion*).

LONDON MATHEMATICAL SOCIETY, at 5.30.—On the Diffraction of Sound by Large Cylinders: J. W. Nicholson.—On the Monogeneity of an Algebraic Function: Dr. H. F. Baker.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lecture on the Theory of Machines: Prof. J. D. Cormack.

MALACOLOGICAL SOCIETY, at 8.—Note of the Dates of Publication of C. L. F. von Sandberger's "Die Land- und Süsswasser-conchylien der Vorwelt," 1870–75: B. B. Woodward.—New Species of Siphonaria, Terebra, and Maugilia, and a Remarkable Form of *Cypraea cruenta*, from South Africa: G. B. Sowerby.—Remarks on some Forms of Chloritis with Description of a New Species: G. K. Gude.—Notes on the Anatomy of S. African Aplysiidæ with Descriptions of two New Species: R. H. Burne.—Notes on *Voluta kenyoniana*, *V. papillosa* var. *costata*, *V. readknighti*. Juv., *Cypraea tigris*. var. *lineata*, and *Conus waterhousae*, var. *mauritiana*: Mrs. Kenyon. Description of a New Species of Crepidula from Victoria: Mrs. Kenyon.

CONTENTS.

THURSDAY, JANUARY 11, 1906.

THE EQUATIONS OF THE WAVE THEORY.

The Analytical Theory of Light. By J. Walker. Pp. xv+416. (Cambridge: The University Press, 1904.) Price 15*s.* net.

MR. WALKER has written a valuable book, but one difficult to review. As he says in his first sentence:—

"The Science of Physical Optics may be regarded as comprising two fields of enquiry; the one includes the study of the physical properties of a stream of light, the other comprehends the investigation of the Mechanism by means of which the stream is propagated. These two divisions may be called respectively the kinematics and the dynamics of the subject."

It is with the first of these that Mr. Walker is concerned; a few experimental facts suffice to show that a stream of light may be represented by a periodically varying vector, transverse to the beam, and on this result, with an appeal where necessary to experimental facts, the treatment of the subject is based.

The appeal to experiment is made as rarely as possible, and as a result we have a book dealing with a physical subject which is almost entirely pure mathematics. Such a book has its value, and in this the value is a high one, for the author has discharged the task he set himself in an admirable manner; but owing to his severe restraint the book lacks interest and its difficulty is increased. It is not a text-book of physical optics, but of the analytical theory of light; the light vector satisfies certain differential equations, and the consequences of this are traced out with a rare degree of completeness. It is a book to which students who desire to know how far the mathematical side of the wave theory has been carried, what are its limitations, and in what directions advances are possible will usefully turn. This knowledge is necessary for the physicist who is more interested in the dynamical theory, for, as Mr. Walker points out, it forms the touchstone on which optical theories are tried, and no one theory of the ether can at present be said to hold the field. No doubt the introduction of even the salient points of the various theories might have had the effect which the author fears of veiling his main purpose; still, the restraint which he has laid on himself has its disadvantages.

Starting with the ordinary geometrical propositions of the wave theory, we come in the second chapter to a discussion of Michelson's experiments and the recent work on the nature of white light; the properties of the polarisation vector are deduced from the non-interference of two beams polarised in planes at right angles. In connecting together the intensity of a beam of light and the amplitude of the polarisation vector, a difficulty is at once met with unless we know the relation between the energy of the stream and the amplitude. For this purpose we require to determine the nature of the vector, and this it is impossible to do without advancing a theory of the mechanism of the transmission, a course which is closed to us. However, the assumption that the square of the polarisation vector measures the intensity is shown to lead to consistent results, and this assumption is made.

The analytical theory really begins in chapter v. with the differential equations of the polarisation vector; the previous discussion has enabled us to express this in the form of a function of $vt-r$, where v is the velocity of propagation, and from these the differential equations are deduced in the usual form, and the important result that when the wave velocity is independent of the period any singularity of phase or amplitude travels with the speed of the wave is shown to follow by a method of proof due to Poincaré; Lord Rayleigh's generalisation in the case when the velocity is a function of the period follows.

Reference had been made in an earlier chapter to Huyghens's principle and its connection with the rectilinear propagation of light; the full proof of the principle depending on the relation at any point within a surface S between a function ϕ_0 satisfying $d^2\phi/dt^2=w^2\nabla^2\phi$ and a certain surface integral taken over the surface of S is then discussed, leading us to Stokes's well known law of the secondary disturbance due to a wave of light, and also to an expression for the disturbance in the neighbourhood of a screen producing diffraction. Fraunhofer's diffraction phenomena are first discussed here; the more complicated cases known as Fresnel's, in which the screen is not at the focus of the light forming the diffraction pattern, follow. The treatment is based on that of Lommel, and deals fully with a rectangular aperture or obstacle, a straight edge, Fresnel's biprism, and a circular aperture and disc. The treatment of the biprism follows Struve and Weber's work.

In chapter ix. an account of some quite recent work by Sommerfeld, Poincaré, and Macdonald dealing with the application of spherical harmonics to diffraction phenomena is given, and after this a short account of Newton's rings and of the laws of reflection and refraction leads to double refraction. For uniaxial crystals the theory is based on Huyghens's assumption, first satisfactorily verified by Stokes, that the wave surface consists of a sphere and a spheroid which touch at the extremities of the axis of the latter, while for biaxial crystals all the laws are deduced from Fresnel's polarisation ellipsoid, a surface which has the property that the velocities of propagation of any wave are equal to the reciprocals of the axes of the section of the ellipsoid by a plane parallel to the wave. Hence the form of the wave surface and the laws of double refraction follow in the usual way.

Chapter xii. contains a number of results on the wave surface which are not easily found elsewhere; in dealing with reflection at a crystal surface, the equations of the polarisation vector in a crystal are first formed, and then the surface conditions are deduced. Free use is made of MacCullagh's ingenious device of uniradial directions. The discussion of the inter-

M

ference of polarised light follows a normal path, but the part relating to biaxial crystals is unusually full. The later chapters deal with absorbing media, dispersion, structurally active media, and magnetically active media; each of these phenomena is shown to follow from suitable modifications in the expression for the light vector; the interesting question of the constitution of the ether which could give rise to such modifications is, of course, in the author's scheme passed by. But while this is necessarily the case, the analysis given is very full and complete, and Mr. Walker has added to the literature of the subject a book of real value. The book has been printed at the Cambridge Press and published by the Syndics, and their share of the work is admirable.

LIQUID CRYSTALS.

Kristallinische Flussigkeiten und flussige Kristalle. By Rudolf Schenck. Pp. viii+158. (Leipzig: Wilhelm Engelmann, 1905.)

THE announcement of the discovery of liquids that were doubly refracting and dichroic by Prof. Lehmann some fifteen years ago was received with considerable mistrust, for the possession by a liquid of these properties which had hitherto been associated solely with the solid crystalline state seemed at first sight almost inconceivable, and quite inconsistent with the generally accepted ideas as to the molecular tactics of liquids and crystals. The very name of liquid crystal seemed to be self-contradictory. Lehmann's results, however, were soon confirmed by other physicists, one of the most active amongst whom was Dr. Schenck, the writer of the present work on the subject.

Several explanations of Lehmann's observations were offered, based on the assumption that he had worked with liquids containing impurities. Quincke supposed them to consist of solid crystalline particles surrounded by a film of liquid, and Tammann endeavoured to explain their properties by assuming them to be an emulsion of two liquid phases. On the other hand, Lehmann pointed out that it was not justifiable to consider these cases as if they were isolated instances of irregular properties, since the behaviour of these liquids apparently so anomalous may be reconciled with that of other crystalline media if we consider the part played by the rigidity of crystals in maintaining their crystalline form. His investigations have shown that the rigidity of different crystals varies within wide limits. The majority of those we know best offer considerable resistance to deformation, while some, like yellow phosphorus, are quite soft, and others, such as the oleates, have so little rigidity that the force of surface tension is sufficient to deform the crystal from its true geometrical shape; in the limiting case, that of *p*-azoxyanisol and the other liquids investigated by Lehmann, the rigidity has become so small compared with the force due to surface tension that the crystal when placed in a liquid of equal density assumes a spherical form.

Lehmann's work was entirely microscopic, but macroscopic investigations were undertaken by other investigators. A study of the physical properties of the birefringent liquids, particularly of their viscosity and dielectric constants, and an unsuccessful attempt to resolve them by cataphoresis, showed that each of them was without doubt a single substance, and thus the hypotheses put forward by Quincke, Tammann, and other authors were disproved.

Prof. Lehmann's monograph on these bodies, which was reviewed in NATURE recently (vol. lxx., p. 622, 1904), consists mainly of an account of the results of his microscopic investigations and of the theory he has formulated to explain these. A very important part of the work was thus left undescribed, and Dr. Schenck's book covers the ground omitted by Lehmann, and, in addition, gives a short summary of the latter's experiments.

The preparation of the various substances that have been found to yield anisotropic liquids is described in detail, also the determination of their physical constants. The investigation of the surface energy of the liquids indicates that there is no sudden change in their molecular weight at the temperature at which the anisotropic liquid passes into the isotropic condition. The viscosity curves, however, show a large break at this temperature, the isotropic liquids being in some cases the more viscous. The density curves show a similar discontinuity. The two liquids have different specific heats, and there is a small but definite heat of transformation of one form to the other.

Dr. Schenck has given a very complete account of our knowledge of these anomalous liquids, which have great interest both for the chemist and physicist, and his book will be of great service to those who wish for information about them. It is clearly written and arranged, and contains a number of diagrams and plates. Of theories as to their nature he wisely fights very shy, and it seems that considerably more work is needed before we shall be able to form any clear idea as to their molecular structure.

H. B. H.

PLANT-BREEDING IN AMERICA.

New Creations in Plant Life: an Authoritative Account of the Life and Work of Luther Burbank. By W. S. Harwood. Pp. xiv+368; 50 illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 7s. 6d. net.

THERE is something to be said in favour of this work; at the same time we imagine no one will have more cause to regret its appearance than Mr. Burbank himself. The reasons for this expression of opinion are easily supplied. It is decidedly desirable that the outside public should be made aware of the enormous practical importance of what is called plant-breeding, and that they should be familiarised with the means and methods adopted by experts for the multiplication and improvement of flowers, fruits, and other vegetable products. A slightly increased percentage of sugar in the sugar-cane or the beet, an apparently trifling improvement in the staple of

cotton, the development of a potato relatively immune to fungous diseases, an increased production of fruit or the introduction of hardier varieties, of some that are earlier, of others that are later, to say nothing of the improvement of flowers in form, colour, and perfume, are all points of great importance and of very great interest from a biological point of view.

In this field of work Mr. Burbank has long been known as an energetic labourer, and it is quite possible that in actual amount his work bulks larger than that of any of his predecessors or his contemporaries. Moreover, as we learn from the book before us, and from other sources, the experimenter is a man of high purpose, modest, and amiable. It is for these personal reasons we imagine that he will have cause to regret the appearance of this volume. We have no desire to belittle Mr. Burbank or to undervalue the importance of what he has accomplished. We believe that he would be the first to acknowledge that there existed strong men previous to the appearance of Agamemnon. But this is a fact that his eulogist does not sufficiently estimate. In perusing the glowing paragraphs of this volume the casual reader might imagine that there were no plant-breeders before Burbank, or that their labours were comparatively insignificant, and yet in our own country alone we seem to have heard of Thomas Andrew Knight, of Dean Herbert, of Trevor Clarke, of Thomas Rivers, of John Laing, of Dominy, of Seden, of Laxton, and of a large number of others whose productions at least vie in importance with those of the American experimenter, whilst a visit to the great establishments of Vilmorin, near Paris, Benary, and others at Erfurt and Quedlinburg, as well as to the trial-grounds of our Veitchs, Suttons, Carters, and many others, would show that the great American hybridist is by no means without a rival in his line of work.

It would hardly be fair to criticise those products of Mr. Burbank's skill and perseverance that have reached us, because it may well be that they are not yet adapted to our climate. At any rate, to name only a few instances, the Burbank plum, the Burbank lily, the Shasta daisy, all so enthusiastically spoken of in the pages of this book and elsewhere, have not, in this country, justified the encomiums passed upon them by the American Press.

When we read of Mr. Burbank's methods of work we do not find anything different from the practices of our "raisers," who are too modest to speak of their efforts as "creations."

Among the "creations" mentioned in this volume is the "thornless edible cactus." Surely we have heard of and seen a spineless Opuntia before attention was called to it in this volume, where it is stated that "nothing more marvellous has ever been done in plant-life"!

Again, "the rare effects developed in the transformation of the columbine" do not differ (so far as we can tell from the illustration facing p. 359) from the stellate columbine known in our gardens for centuries and figured on p. 273 of Parkinson's Paradisus (1629).

A man who has experimented on such a colossal scale for so long a time might be expected to have gathered valuable information on such points as heredity, adaptation, inheritance of acquired characters, as well as formed opinions on Mendelism and mutation. We gather from the book before us that Mr. Burbank's attention has, almost of necessity, been directed to these subjects, and we earnestly hope that now that the Carnegie Institution has granted him a subvention of ten thousand dollars a year for ten years he will find time to record and coordinate his experiments for the benefit of future workers and the increase of biological knowledge.

Incidentally, we glean that Mr. Burbank is not inclined to accept the views of Weismann or of Mendel, but that he looks favourably on the mutation theory of De Vries. Surely no practitioner has had better opportunities of judging of these matters than has Mr. Burbank, and if he will give us his own experiences in his own words, rather than in those of some too partial biographer, the world will be the gainer, and the value of Mr. Burbank's work more accurately gauged than it can be from the perusal of the present volume.

CHEMICAL TECHNOLOGY.

Chemische Technologie. By Dr. Fr. Heusler. Pp. xvi+350. (Leipzig: B. G. Teubner, 1905.) Price 8 marks.

THE author states in the preface that the work is intended for the use of merchants. This at once opens up the question whether a book of this kind, ostensibly written for non-chemists, can fulfil its object. The author is under the impression that a merchant has acquired, in the course of his secondary education, sufficient knowledge to read and interpret chemical equations, and he adopts in his work chemical symbols throughout, in the belief that it would be almost an insult to the German merchant to think him incapable of understanding chemical equations.

The reviewer cannot agree with this opinion in its broad generality. His own experience would lead him to confirm in this respect the truth of the trite old saying, "A little knowledge is a dangerous knowledge." When the commercial director of a chemical works asks his chemist, in times of stress, to use a sulphuric acid of 50° Bé instead of 66° Bé on the score that the former is so much cheaper for the same amount of sulphuric acid, or when the chief clerk struts through the works meddling with the chemistry of the business, then the chemist would certainly prefer the English system of subdividing the work. Of course, there are merchants who are fully able to understand purely chemical questions, but such merchants would certainly have recourse to the extensive manuals on their own specialities rather than study the present work, in which the information on every subject must necessarily be very meagre.

From this point of view the book is not within the horizon of the average chemical merchant. The tendency to explain the subject so far as possible by equations necessarily leads to a twisted and sometimes wrong representation, as these may be read to

mean complete chemical changes, whilst often enough they only express part of the chemical change that is going on. Statistical data, the most useful information to a merchant, are very imperfectly given. Whilst, *e.g.*, the statistics of ammonium sulphate refer to the years 1902 and 1903, other more important branches of chemical technology hark back as far as the 'eighties of last century.

If the question be asked whether this book would prove useful to a chemist, a much more favourable opinion can be pronounced. The work will be found very helpful, as a kind of "Repetitorium," to a chemist who is reading up for examination. Regarded in this light, the book may be said to have been written concisely and to contain an enormous amount of information, put together in a clear and transparent form. Naturally, the attempt of one single author to press the wide range of chemical technology into one small volume carries with it the germ of defect. For in the present state of chemical technology it is clearly impossible for any single person to write on every branch with the necessary authority or even necessary knowledge. The inevitable consequence of such an ambitious endeavour is that books of this kind bear too patently the stamp of writing-desk work. Only in the case of the electrolytical processes dealing with alkali chlorides the author has called in the assistance of an expert. He would have done well to have extended this invitation to other specialists. We therefore find throughout the book many statements which could have been put right by an expert, and we also notice some important omissions. Moreover, some of the weakest chapters, such as those on "leather industry" and "fats and oils," would have been brought into line with the aforementioned chapter on electrolysis. The least satisfactory part of the book are the illustrations. Some of them have done service for half a century, and might have been given their well-earned rest. Others are more in the nature of pictures which convey no information. Others, again, such as the illustration of a native indigo plant, can only provoke a smile.

J. L.

OUR BOOK SHELF.

Future Forest Trees. By A. H. Unwin Pp. 108. (London: T. Fisher Unwin, 1905.) Price 7*s.* 6*d.* net.

WITHIN recent years our forestry literature has been rapidly and steadily on the increase, which may be taken as a sign that more attention is now being given to matters sylvicultural than formerly. The above work is one of the most recent additions, and its thoroughly sound, practical, and scientific character should secure it a wide circulation, not only in this country, but also in America, to which it equally refers.

The title chosen by the author, "Future Forest Trees," refers to those exotic, deciduous, and coniferous species of East, West, and North American trees which might with advantage be introduced into our forests. The work embodies the author's own personal experience, as well as the results gained by more than 100 years of extended experiments which have been carried out in Germany.

The selection of exotic species as future forest trees is not by any means so easy a task as one might at first sight suppose. To justify its introduction and cultivation the new species must have some distinct advantageous characteristics which are not possessed by our indigenous trees, such as greater rapidity in growth, greater resistance to adverse climatic conditions (for example, wind, heat, cold, rain, and snow), greater adaptability to the poorer classes of soil, and such like.

It is to Prof. H. Mayr, of Munich, to whom this book is dedicated, that we are indebted for so much valuable information on this very important question, especially as regards the geographical distribution of forest trees.

The first part of the book deals with the imports of American timber to the German market. Importing timber to Germany, the home of forestry, sounds a little like carting coals to Newcastle; nevertheless, there are at least two sufficient reasons, firstly, because some of these timbers are at present not cultivated in that country, and, secondly, it is a well-known fact that the world's supply of timber is not inexhaustible, and is, in fact, rapidly on the decrease. Hence, while Germany can obtain timber at a reasonable price from abroad, she is conserving her own forest reserves with the full knowledge that at no very remote date the price of timber will have risen to a figure which will amply justify this policy of conservation. Part ii. gives the general results of planting experiments with American trees in Germany, Austria, Great Britain, and Switzerland; and part iii. deals with the sylvicultural characteristics and treatment of the various American species of trees.

We heartily commend this book to all those who are interested in or connected with forestry, as it forms an excellent guide to the cultivation of species which are likely in the course of time fully to justify their introduction.

Elements of Quantitative Analysis. By Dr. G. H. Bailey. Pp. x+246. (London: Macmillan and Co., Ltd., 1905.) Price 4*s.* 6*d.*

AFTER the consideration of some preliminary matters, the author, within the compass of less than two hundred small pages, treats of almost every branch of quantitative chemical analysis, including minerals of many sorts, water, fuel, the products of alkali factories, manures, organic substances, soap, oils and fats, and gases. It follows that the space devoted to each section is very small, and in many cases it would be more correct to say that the methods are indicated rather than described. This economy of words and space sometimes leads to instructions that might cause accidents, as in the description of Kjeldahl's method of estimating nitrogen, where the student is instructed to boil the substance with fuming sulphuric acid, &c., then to "allow to cool and add a tolerable excess, about 50 grams will suffice, of caustic soda. . . . Distill off the ammonia," &c. In other cases the desire to be brief leaves the student without instructions, as in the analysis of water, in which he is told to determine the free and albumenoid ammonia, and referred for the method to a simple description of the estimation of ammonia by Nessler's solution. On the other hand, it is a pleasure to notice that some methods are given that are not generally known, such as the colorimetric estimation of titanium by means of hydrogen peroxide.

The educational value of the work suggested (to which the author refers in his preface) would have been enhanced if the chemistry of the operations and the specific aims of the advisable manipulative pre-

cautions had been given more fully in a few preliminary cases, so that the student might have been helped to understand thoroughly his early exercises. As he gets more advanced he ought to refer to standard works and original treatises. Then this present volume will furnish an excellent series of suggestions as to work that may be done in many directions in order to gain experience and increase his knowledge. C. J.

Elementary Dynamics. By W. M. Baker. Second edition, revised. Pp. x+318. (London: George Bell and Sons, 1905.) Price 4*s.* 6*d.*

THIS text-book follows ordinary lines. The author does well to direct the attention of the beginner at the outset to the fact that *weight* and *mass* are by no means the same thing. Newton's laws are given almost unchanged in words, the second being altered to "rate of change of momentum is proportional to the impressed force, &c." The word *rate* is, in strictness, ambiguous, since it does not necessarily imply time-rate; and the explanation (p. 33) that "rate of change of momentum" means the change of momentum *in* the unit of time is not quite accurate, since the unit of time may be an hour or a week. The poundal figures a great deal; but, happily, as a rule, the values of forces are given in gravitation measure in the answers. The antiquated and inaccurate terms *power* and *weight* are used in the discussion of machines, although *power* has been very properly defined as time-rate of doing work. The old method of defining the instantaneous value of a variable angular velocity as "the number of unit angles which would be described in the unit of time, if during that unit the angular velocity remained the same as at the instant under consideration" is adhered to; but this definition defines nothing. The author is commendably clear in his warning to the student that "centrifugal force" is not a force acting on a revolving body. In the discussion of projectiles, the eye is not pleased by the sight of "$u \sin at - \frac{1}{2}gt^2$" for $ut \sin \alpha - \frac{1}{2}gt^2$; and it is just possible that a beginner may (by the inscrutable ingenuity for error which students sometimes exhibit) misunderstand the expression altogether.

The book contains a very large collection of examples, and has, as a slight departure from the plan of ordinary text-books, a short chapter at the end showing how initial tensions are calculated when cords are cut or broken.

A Historical Geography of the British Colonies. By C. P. Lucas, C.B. Vol. ii. The West Indies. Second edition, revised by C. Atchley. Pp. 348; diagram and maps. (Oxford: The Clarendon Press.) Price 7*s.* 6*d.*

THIS valuable work has been published at an opportune moment, for the decisions of the Imperial Government in such matters as the withdrawal of the white troops and the non-renewal of the mail contract have led to a widespread idea that our West Indian possessions are about reaching the most momentous stage in their long history, namely, their transfer to the United States—an extreme step which is hardly likely to be taken in our time. The volume deals not only with the West Indian islands proper, from Jamaica round to Trinidad, but also with the Bermudas, the Bahamas, the mainland colonies of Guiana and Honduras, and even the far distant possessions in the Cape Horn region—the Falkland Islands and South Georgia. The total area aggregates 127,345 square miles, Guiana alone being 100,000, and Honduras 7562 square miles. The remainder is cut up into a multitude of small islands, ranging down to the Bermudas group, of 19 square miles. Yet each island, however small, has its own separate history. Originally the Spaniards had Papal authority for taking possession of the New World, but they were not a colonising people, and as "conquerors and crusaders they looked for a large area of territory; consequently, while they discovered the whole ring of islands, they settled on the larger ones only, and on those only which lay nearer to the continent. With the smaller islands they had little dealings beyond carrying off their inhabitants for slaves." There was thus no effective occupation of the large majority of the islands, and English, French, and Dutch buccaneers appearing on the scene, in the course of time they divided the islands between them, the lion's share eventually, as the result of treaties or wars, falling to the English. The earliest of the British possessions was Barbados (1605), the latest, by conquest, St. Lucia and Tobago (1803). Obviously, within the compass of a single volume, only a general historical account of each colony could be given, and Mr. Lucas has accomplished his task most successfully. But in addition to the purely historical portion he supplies much information relating to the geography, the geology, and the climate of the islands—as varied as their history. The economic conditions are also fully set forth, the particular industries of the several islands, their exports and imports, and so on, while the form of government of each colony is described. There is a very complete index, and at the end of each chapter there is a list of books and publications which will afford the reader fuller details, many other authorities being referred to in footnotes.

Vorlesungen über mathematische Näherungsmethoden. By Dr. Otto Biermann. Pp. ix+226. (Brunswick: Vieweg und Sohn, 1905.) Price 8 marks.

THE aim of the author of this book is to give a connected and fairly comprehensive account of the most important mathematical methods of approximate calculations. Strictly speaking, all scientific calculations are approximate; but by suitable processes the approximation may be carried to a degree of accuracy sufficient to satisfy the most exacting requirements. How best to effect the approximation in any given case must ever be a most important problem. The necessity for it begins with ordinary arithmetical operations, to which, accordingly, Dr. Biermann devotes a large part of the first chapter. A good deal of detail might have been spared here if only to make room for a complete account of Horner's method of solving numerical equations and extracting roots. The algebraical theory only of Horner's method is given in a later chapter, but not the expeditious arithmetical process. To give an idea of the scope of the book, we find systematic discussions of the calculations of logarithms, graphical solution of equations, methods of interpolation and differences, determination of Fourier coefficients, methods of quadrature and cubature, and a chapter containing, among other things, a description of the sliding scale and Amsler's planimeter. There are some interesting novelties in the sections on graphical solution of equations which might well find a place in our English text-books of algebra, such, for example, as Mehmke's method. The book does not cover all the ground indicated by the term *Näherungsmethoden*, but it certainly covers more ground than any other book. Indeed, it fills what has been until now a distinct blank in mathematical literature; and the author is to be congratulated on the production of a work which cannot fail to be of service to the student of mathematical methods.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Insectivorous Water-plant from Trinidad.

SPECIMENS of the carnivorous water-plant from the Trinidad Pitch Lake, referred to in the note on p. 230, have been received at Kew from Mr. Hart. It is not, however, as supposed, "a species of Nitella," which is an aquatic cryptogam, but a flowering plant, and a species of Utricularia.

The habits of these plants are fully discussed in Mr. Darwin's "Insectivorous Plants."

W. T. THISELTON-DYER.

Kew, January 5.

The Maximum Number of Double Points on a Surface.

IT is obvious that a surface, like a curve, must have a maximum number of double points; and it is also obvious that all of them may be *conic nodes*, but only a limited number of them can be *binodes*; but so far as I have been able to discover, no formula has been obtained for determining the maximum number. In Hudson's book on "Kummer's Surface," a proof is given that a quartic surface can have as many as sixteen conic nodes, but no general theorem is alluded to. I shall therefore state a formula by means of which the maximum number can be calculated.

Let a surface of degree n and class m have C isolated conic nodes. Let $\bar{\iota}$ and ι be the number of double and stationary tangents possessed by any plane section of a tangent cone the vertex of which is an arbitrary point. Then it is not difficult to show that

$$m = n(n-1)^2 - 2C \qquad (1)$$

$$\iota = 4n(n-1)(n-2) - 6C \qquad (2)$$

$$2\bar{\iota} = \{2C - n(n-1)^2 + 5\}^2 - \{n(n-1)(3n-14) + 25\} \qquad (3)$$

Now ι and $\bar{\iota}$ must be zero or positive integers; also m must be a positive integer which does not fall below a certain limit, and these conditions will in general be satisfied by taking

$$2C - n(n-1)^2 + 5 = \pm k,$$

where k is the least odd integer the square of which is not less than $n(n-1)(3n-14)+25$. The sign of k must be determined from the above mentioned conditions, and should the least value of k fail to satisfy them a greater one must be taken.

A. B. BASSET.

January 2.

Sounding Stones.

MANY hard and compact varieties of rock are sonorous when struck. Flint nodules often possess this property. The purity of the tone appears dependent upon the length, calibre, and homogeneity of the nodule, the best results being obtained from the long and slender forms. At Studland Bay I have collected many of these "musical" flints, and obtained one from a chalk pit near Faversham which can be used as a gong when suspended. This particular specimen is nearly 2 feet in length (it was once longer), and is scarcely as thick as a rolling-pin!

Many years ago I saw a "rock harmonicon" in the museum at Keswick. It was formed of strips of rock (known as "clinkstones") arranged on the principle of the dulcimer, upon which various tunes could be played.

The phonolite of the Wolf Rock, nine miles south of the Land's End, possesses sonorous properties, and Sir Wyville Thomson has described St. Michael's Mount, an island near Fernando Noronha, as being entirely formed of phonolite which "literally rings like a bell" on being struck.

In quarrying the rock from the Whit Bed, at Portland, the workmen profess to be able to judge of the quality of the limestone by the clearness of the metallic ring emitted from the blocks on being struck.

January 5. CECIL CARUS-WILSON.

Heat a Mode of Motion.

THROUGHOUT Swedenborg's "Principia," published in 1733, both heat and light are constantly regarded as ethereal undulations. The definitions of heat as a rotary movement of minute ether particles will be found in part iii., chapter v., No. 21; chapter vii., No. 10; chapter viii., Nos. 8, 9, 10, 16.

The following is from the "Principia," part iii., chapter vii.:—

"Whatever the ether presents to our organs by means of colours, the air presents to us by means of modulations and sounds. Thus Nature is always the same, always similar to herself, both in light, and in sound, in the eye and in the ear; the only difference is that in one she is quicker and more subtle, in the other slower and crasser."

Although this is not an example from the seventeenth century, it anticipates the theories of Rumford and Young as to light and heat by some sixty years.

CHARLES E. BENHAM.

Colchester, December 23, 1905.

The Naming of Colours.

PERHAPS some of your readers would be interested in, and could suggest some explanation of, the following rather fanciful colour term. A light purple, almost a mauve, is called by the Chinese 雪 (süt_0) 青 (Ts'eng), 色 (shik,) "snow green colour." I have asked many educated Chinese for some explanation of the name, but the best I can get is the Chinese are very "fanciful" in the use of colour terms. I may say that the term I have translated "green" is sometimes applied by the Chinese to the colour of the sky.

ALFRED H. CROOK.

Queen's College, Hong Kong, December 2, 1905.

Aurora of November 15.

THE aurora of November 15, 1905, was seen at Szczawnica, in Galicia (Karpathian Mountains), by the meteorological observer Mr. Wojakowski at 9h. p.m. M.E.T.

The day of November 15 and the subsequent night were in Galicia cloudy and rainy. Probably the sky was clear for a while at Szczawnica. The altitude of Szczawnica is 484 metres; longitude, 20° 30′ E. of Greenwich; latitude, 49° 26′ N.

M. P. RUDZKI.

K.K. Sternwarte, Krakau, January 1.

Ascent of Sap in Trees.

WITH reference to an article on the above subject which appeared in your issue of October 26, 1905, the following extract from a paper—which your contributor has doubtless not seen, published nearly ten years ago—will probably interest some of your readers.

FRANK HARRIS.

Maryland, Saundersfoot, December 25, 1905.

EXTRACT FROM *Indian Engineering*, FEBRUARY 8, 1896.

Ascent of Sap in Trees.

Among the various theories which have been advanced to explain the circulation of sap in plants, those dependent on purely mechanical principles are, as has been pointed out, entirely untenable. That hypothesis which relies solely on the osmotic action of the root hairs, though adequate in itself to account for the rise of water to almost any extent, is not compatible with the so-called "negative" pressure observed to exist in the vessels of living timber. The last mentioned among the explanations to which allusion has been made—that which invokes the aid of what may be loosely described as the vital principle—though unobjectionable in itself, unnecessarily complicates

the question; and while some of the difficulties which present themselves upon detailed examination may be overcome, others are less easily surmounted. In the trunk of a tree it is only the cambium itself which can properly be regarded as consisting of living cells—if we use the expression in its usual sense. Besides protoplasm the cambium cell contains a nucleus, and splitting up to form the growing wood is evidently and unquestionably a living cell. The sap cannot, however, be considered as entirely rising through the cambium alone; while the medullary rays and wood-parenchyma, although they both contain protoplasm or such like organic substances, are in no other respects like living tissue. They may be regarded simply as store houses containing nutritive matter, or as actively engaged in the plant's circulation, or as acting in both capacities; but scarcely can they be described as centres of vitality.

The theory which most readily commends itself to our ideas of probability is that which regards osmosis as the primary and all potent cause of the sap's ascent in plants; not taking place in the root alone, as was supposed by those who advocated the earlier theory, but active throughout the whole height of every tree. Concerning osmosis itself it is well to remember that the phenomenon contains nothing transcendental or beyond the reach of ordinary molecular physics for its complete explanation. We know that the particles of a liquid, though far from possessing that mobility which in a gas is due to the great extent of free path enjoyed by its molecules, are constantly in a state of translational motion with regard to each other. The phenomenon of diffusion in inorganic solutions obviously suggests the conclusion that this capacity depends largely upon the relative simplicity which characterises the molecule's construction. Especially is this idea forced upon us when considering the relative diffusibility of various solutions. Here we find the rate of diffusion bearing a definite relation to the solution density; the square of the time of equal diffusion being in the case of such solutions equal to their solution density. It would appear, apart from all questions of chemical combination, that each molecule—or perhaps group of molecules—of the solvent becomes attached to a certain number of molecules of the dissolved substance; this complex group holding together so far as diffusion and osmosis are concerned. Under such circumstances it is only to be expected that the rate of diffusion, which means the passage through intermolecular fluid spaces, or of osmosis, which consists in the passage through interstitial spaces in a porous solid, should vary quite as much as is observed to be the case.

It is true the relatively small differences in the rate of passage through porous bodies observable when inorganic solutions are compared with each other, seem to depend principally upon chemical action between the solutions and the substance; but in the much more marked difference observed when we compare the dialysis of crystalloid and colloid bodies, this does not depend on any such action.

Now in a plant we have a system in which the process of nutrition is going on at both ends, the roots and the leaves of a tree; it is, however, the organic colloid substances which are manufactured in the leaves, while in most part inorganic or crystalloid compounds are absorbed by the roots Both forms of nutriment are required at every point of the tree. The colloids have to descend, the crystalloids and water have to be raised. Constant evaporation from the leaves by maintaining "negative" pressure in the vessels greatly facilitates the rise of water from below; but the motive power is osmotic action taking place between any or every pair of cells in the chain. The "air bubbles" which form a *chapelet de Jamin* in the vessels and prevent the fall of any water previously raised by osmosis, at times when demand falls or moist air saturating the leaves supplies all water necessary from above,' very possibly convert the fluid column itself into the equivalent of a porous body suitable for the action of osmosis to make itself felt between each pair of drops as they hang suspended in the vessels. The film of liquid surrounding each bubble is as a narrow space in a porous body through which the simpler and smaller groups of atoms can more readily pass than can that cumbrous collection which constitutes the physical molecule of any colloid solution. This action adapts itself exactly to the plant's requirements. Should any sap fall short at any point of water or crystalloid solution, osmotic action immediately supplies what is required from below; while the enormous pressures which dialysis can bring into play leave gravity *une quantité negligeable*. The details characterising this action as observable in conifers, as distinguished from dicotyledonous trees, will doubtless vary. The former suggest to most unbotanical minds the idea of an earlier and less highly developed type. The tracheides of a conifer act simultaneously as conducting vessels and as hollow cells in the structural framework of the trunk considered as a beam; while these purposes are more or less differentiated in the case of dicotyledonous plants. In this latter case the wood-parenchyma cells surrounding the "vessels"—filled as they are with colloid matter—appear to supplement the action of the medullary rays, not here in such close connection with conducting tracheides as they are in the case of conifers. The presence of all this colloid matter, scattered throughout the conducting mass and closely connected with the tracheides or with the fitted vessels, probably act as a reservoir and enlarge the sphere of the osmotic action, thus avoiding violent changes and preventing any very noticeable difference in sap density occurring throughout the tree's height. A gradient, however, marking difference in proportion between colloids and crystalloids must necessarily exist whenever water is rising, and this would naturally be expected to follow the introduction of these different forms of nutritive matter at opposite ends of a chain.

ELEMENTARY GEOLOGY.[1]

IF a new elementary text-book of geology is really in request, no better author could be found than the president of the Geological Society of London for 1905. We venture to prefer this work to his somewhat similar "Agricultural Geology," and hope that candidates for a diploma in agriculture will now make use of both. The author, while engaged upon his task, appears to be absolutely devoid of the emotion which "nature-study" provokes in other men in various measure, and his introduction, if a little cold, should lead to accurate observation and understanding. The photographic illustrations are refreshingly large, and include successfully the forms of familiar fossils and even of flint implements. Four pins fixed in a dull white wall would, however, have served as a more satisfactory support for a helpless belemnite than the operating table and other apparatus displayed in Fig. 29. The striking relic of a Triassic land-surface, photographed by Prof. H. E. Armstrong (Fig. 27), is here reproduced, as an example of the admirable landscapes in this volume.

Our only question about the book is as to the class for whom it is intended. In the frequent absence of systematic scientific training in English schools—things are fortunately different now in Ireland scholars may come up to our universities completely ignorant of chemistry and physics. They may also be ignorant of the animal and vegetable forms around them, and they are certain to believe that coral is a substance laboriously manufactured by an insect. We take it that, on contact with Dr. Marr and the well-known Woodwardian collections, such scholars may become attracted towards geology. Hence, in the present work, this complex subject, relying for its evidence on almost every other science, is treated as one to be laid before babes, who have never handled a blowpipe, or stroked the back of a cat to see that it possessed a spinal column. From these pages the reader may "proceed to the perusal of more advanced treatises." But what

[1] "An Introduction to Geology." By J. E. Marr, Sc.D., F.R.S. Pp. viii+230. (Cambridge: University Press, 1905.) Price 3s. net.

is to be his course of study in between? Before the advanced treatise, or, at any rate, such a one as Dr. Marr would approve, can be really entered on and appreciated, the student must surely have some practical acquaintance with carbon dioxide and silica as chemical substances, with "boneless animals" and "those possessing bones," and with other matters that are here mentioned as if they were absolutely new to his intelligence. On pp. 224 and 225 the beginner is sent out into the open country as his "true museum." This is excellent advice for the true beginner in geology, but not for those beginners in science whom Dr. Marr, from his experience of English public schools, finds himself compelled to contemplate.

Among the excellent points in the present treatise we notice the early introduction of conceptions of crust-movement, which render descriptions of other phenomena far more easy of comprehension; the reference to what is often known as "plucking" in the action of glaciers (p. 57); and the concise account of plains of denudation (peneplains) on p. 99. Among the very few slips, we may note that Kimeridge (p. 179) is in Dorset, not in Wiltshire; that the insoluble part of felspar (p. 79) does not by itself form china-clay; and that the phrase "evaporation of water by the sun" (p. 67) is scarcely a happy one. The fan-structure on p. 93 is, we think, not that usually thought of in connection with the term.

On p. 65 we must invoke subsidence of the crust to enable the sea to perform all the work there claimed for it; and we should like more sympathy on p. 89 with the view that the earth is continually losing moisture from its interior. Lastly, the author (p. 181) should not, even by an accident of phraseology, encourage a belief in the existence of "fossil thunderbolts." But these small asperities only give an edge to our appreciation. GRENVILLE A. J. COLE.

FIG. 1.—Wind-worn surface of older rocks (on right), revealed by removal of New Red Sandstone, Charnwood Forest. Landscape of Triassic times. (From Marr's "Introduction to Geology.")

TIDAL RESEARCHES.[1]

ONE of the crowning features of the enunciation by Newton of the law of universal gravitation consisted in the fact that herein the phenomena of the tides and their relationship with the moon could for the first time be coordinated with other well-known phenomena of the solar system. Though the principal phenomena of rise and fall and ebb and flood of the sea must have been recognised by coast dwellers and navigators from the earliest times, the theory of the tides as it exists to-day may fairly be said to have originated with Newton, and its purpose has largely been to examine to what extent these phenomena are attributable solely to a gravitational cause or how far it may be necessary to invoke some other exciting or controlling influence.

It was early recognised that a theory which failed to take due account of the inertia of the water, of the earth's rotation, and of the curvature of its surface could but inadequately represent the phenomena actually existent in nature, and the reduction of the tidal problem to a mathematical form in which all these features were duly taken into account was first accomplished by Laplace; since his time the equations furnished by him have formed the basis of almost all attempts to further the study of the tides from its purely theoretical aspect. The theory of tides in narrow canals developed *in extenso* by Airy, though not directly based on Laplace's equations, consists largely in the discussion of a special type of solvable cases of the more general mathematical problem propounded by Laplace. In the memoirs under review the author emphasises the hopelessness of such attempts to realise their main purpose of providing a theory sufficiently exact and yet sufficiently general in character to allow of direct comparison with observations, as is the practice in the study of other gravitational phenomena such as the planetary motions, and proposes a new method of attacking the problem. An essential difference between this method and that of Laplace consists in the fact that in the former the influence of the earth's rotation is regarded as of secondary importance. Such solutions of Laplace's equations as have been obtained, which allow of an exact estimate of the

[1] "A Manual of Tides." Part iv. A, Outlines of Tidal Theory. Part iv. B, Cotidal Lines of the World. By Rollin A. Harris. Appendices to Reports of U.S. Coast and Geodetic Survey.

influence of the rotation in the restricted problems dealt with, by no means appear to justify this course.

If, however, a complete tidal theory which should adequately account for all the phenomena of observation has hitherto been found wanting, at least considerable advance in the coordination of observed phenomena has been obtained by the introduction of the harmonic analysis for the discussion of tidal observations, while tidal records suitable for such analysis have accumulated. These, so far as they are accessible at all, are scattered through various scientific publications, and the author has rendered a valuable service to all interested in tidal phenomena in collecting them in tabular form in a single memoir. The tables given on pp. 664–677, part iv. A, and pp. 342–351, part iv. B, contain the results of the harmonic analysis of tidal observations taken at more than four hundred stations distributed throughout the world, and probably contain almost all information of a precise character in relation to the tides at present available. These tables give the amplitudes and phases of the principal types of oscillation as derived from observation alone, and only involve theory in so far as it enables us to assign the periods in advance by means of exact astronomical data. It is to be regretted that in no case is any indication given of the degree of precision with which the analysed results reproduce the actual observations from which they are derived, or of the extent to which they confirm the theory on which they depend.

A considerable portion of the memoirs is further devoted to an attempt to coordinate the results derived from different stations so as to form a comprehensive picture of the general progress of the tide-wave over the surface of the ocean, and the results are exhibited in a series of charts indicating the position of the wave crest at each successive cotidal hour.

The construction of these charts is, unfortunately, but vaguely indicated. As already stated, no ready means is provided of estimating the value of the material used for the purpose, or of the methods used for its combination.

In so far as these charts are based on the results of observation alone we are prepared to believe that they give a fairly accurate representation of the actual tides in the regions where observations are sufficiently numerous to supply the necessary information, but, as is well indicated in the cotidal chart due to Berghaus and reproduced by the author, there will remain very considerable tracts of the ocean surface about which no observational information is available, and which are left blank on the charts prepared by Berghaus. In fact, as tidal observation is almost of necessity confined to the neighbourhood of the coast lines, the only method of filling in such blanks is to have recourse to theory, and the correctness or otherwise of the charts prepared by the author must therefore depend to a very considerable extent on the correctness of the theory which he has put forward, which forms the principal subject of Part iv. A.

This theory has already been the subject of adverse criticism in NATURE (September 4, 1902, p. 444), and we cannot but regret that we have to adhere to the objections to it previously raised.

Without reverting to these objections it is rather our purpose here to examine the particular applications of it now dealt with in part iv. B, which constitute the chief purpose for which it was designed. The object of the author, as he himself expresses it, is "to obtain through theoretical considerations . . . a first approximation to the times of the principal ocean tides," *i.e.* the phases of the oscillations in relation to those of the disturbing forces which produce them. The times in question are deduced from a theorem based on the analogue of the compound pendulum which asserts that in maintained simple harmonic motion under the action of friction "the virtual work of the external periodic forces is zero at the instant of elongation." If we rightly understand the significance of this theorem, it would appear to imply that, at the instant of elongation, the disturbing forces which give rise to the type of motion under consideration form an equilibrium system. We conclude either that they are in equilibrium throughout the motion or that they are in equilibrium at this instant in virtue of the fact that their resultant, which is *ex hypothesi* of a simple harmonic character, is passing through its zero phase. The former hypothesis may be dismissed as giving rise to no permanent oscillation; the latter indicates a phase difference of a quarter of a period between the phase of the oscillation and that of the resultant disturbing force.

The application of the theorem in question to the tidal problem is somewhat obscure, but the illustration of the simple pendulum presented by the author enables us at once to recognise an essential condition under which it is applicable. The phase difference in this case is correctly expressed by equation (297), which indicates in general a phase difference of zero or half a period when friction is slight. When, however, friction is sufficiently great the phase difference may amount approximately to a quarter of a period, and the same will be true even with small friction when there is an exact coincidence between the period of the disturbing force and the "natural" period of vibration of the pendulum.

Thus the fundamental theorem on which the determination of the phase depends only holds good if we regard friction as sufficiently large to control the phase, and unless the relative influence of friction in comparison with other causes which influence the phase is in some way known, the phase will remain quite indeterminate. Of course it may be contended that in the case of the tides the conditions necessary to render friction the controlling factor exist, but this contention is nowhere put forward explicitly by the author, and we are of opinion that it could not be substantiated. We are further of opinion that the effects of friction on phase will be everywhere comparatively insignificant, so that we should expect to find the phases of the oscillations, so far as they can be resolved into separate simple harmonic types, approximately in agreement with (or differing by half a period from) those of the disturbing causes instead of, as the author's theory requires, differing from them by a quarter of a period. We conclude that the author's theory ceases to be available even to lead to a "first approximation" in the determination of the phases.

We can thus only regard the charts produced, except in so far as they are controlled by direct observations, as a speculation on the part of the author unsupported by scientific evidence, and regret that an otherwise painstaking and far-reaching research on our existing knowledge of the tides has been marred by the intervention of an unsatisfactory theory which we feel bound to regard as not merely inadequate, but for the purposes to which it is applied actually misleading.

S. S. H.

AGRICULTURAL EDUCATION AND COLONIAL DEVELOPMENT.

IN a paper on "The Teaching of Agriculture" read by Mr. F. B. Smith, director of agriculture in the Transvaal, before the British Association, there occurs a statement which is of special interest to educationists and to the public of this country. The paper was read with the object of directing attention to the keen desire for agricultural education that now exists in South Africa, and to the improvements in the condition of the colonies which might be looked for if a satisfactory system of education and research were established. But though colonial Governments are willing, and the enlightened members of the agricultural community are anxious to get on, progress is slow, and chiefly because suitable teachers for agricultural colleges and other officers for colonial departments of agriculture are hard to find. The words used by Mr. Smith are:—"The difficulty of obtaining men qualified to fill such positions is great, and frequently one of two things happens: either an *unsuitable man from the Homeland* (the italics are ours) is appointed, with the result that a department is seriously hampered or discredited, or a selection has to be made from abroad. I am not speaking without experience, for I could give many examples in support of my argument that a great deal of harm has been caused to agricultural administration and education in the colonies by the sending out of inexperienced and unsuitable men from Great Britain." Again, after stating that the demand will continue, and is likely to increase, Mr. Smith asks, "Cannot some steps be taken to improve matters, and to supply the want?"

Unfortunately it is not only in South Africa that the Mother Country's insufficiency is being felt, for within the past few years there has been quite an extraordinary awakening to the value of agricultural education in the British possessions, and the Homeland has not been able to afford the guidance and assistance which her colonies expect. That there is an awakening we have ample evidence; thus a recent number of the *West India Bulletin* informs us that the president of the West Indian Agricultural Conference of 1905 remarked:—"Agricultural education is at the root of the successful development of these colonies," and another speaker referred with surprise to the rapid rise in importance of this subject. Again, from the Indian Financial Statement for 1905 we learn that the Government of India, which in 1902–3 spent about 60,000*l*. on improving agriculture, has now sanctioned an expenditure of 250,000*l*. for the provision of agricultural institutions, experimental farms, &c. But although this forward policy has the approval of all sections of the Indian public, it must wait, for in India, as in South Africa, the problem is to find men competent to give effect to the policy.

The director of agriculture for the Transvaal is perhaps too severe on the "unsuitable man from the Homeland." The good work accomplished by this same "unsuitable man" in the past ten years has been one of the chief causes of the rise in popularity of agricultural education. But it must be admitted not only that men are hard to find, but that when found they seldom have the training which is desirable. The fact is that Britain still looks upon agricultural education purely from the national standpoint, and gives no thought to her colonies. Through the Board of Agriculture, agricultural institutions in England and Wales receive about 10,000*l*. per annum; but these grants are made to provide for the education of the English farmer, and without reference to our foreign possessions.

A few weeks ago a deputation waited upon the Board of Agriculture to ask that increased grants might be given for teaching and research in connection with English agriculture, and it was admitted by the Board that further aid in this direction was desirable. If the present grants are insufficient for the special needs of this country, it is clear that they are quite inadequate for the requirements of Greater Britain. It may be argued that India and the colonies should provide for themselves; but we hope that Mr. Smith's question may not receive this answer. Greater Britain makes the reasonable request, "If you send us men, send us trained men," and if we neglect this request our colonies must find men elsewhere. They cannot mark time indefinitely, nor can they risk their prosperity by engaging the services of incompetent men.

England is herself content with her small outlay on agricultural education and research, but we must not conclude that what is good enough for the Mother Country is good enough for her colonies. English agriculture is highly developed, is conservative in its methods, and there is no agricultural party to be reckoned with by the English statesman. We do not ask for, and we do not get, the assistance claimed by the farmers of countries like Denmark and the United States. In India and the colonies it is different; agriculture is undeveloped, applied science may do much for the farmer, and the prosperity and contentment of the agriculturist are of great political importance. Though, therefore, the English agriculturist does not complain of the meagre endowments of agricultural science, we must not assume that those responsible for the development of Greater Britain will remain satisfied with what this country is now doing. The colonies have hitherto taken our men, because men trained in British schools and universities have been their traditional leaders; but it is clear that if we wish them to continue to do so we must make greater efforts to meet the new demand.

Nothing could possibly be more damaging to the reputation, not only of English teachers of agriculture, but of England, than such an experience as the director of agriculture for the Transvaal recorded before the British Association. If our men are incompetent, if they are unfit to lead, the sooner, not only our teachers, but our statesmen, take the matter up the better. The colonies must know, and without delay, that the universities and colleges of this country can supply trained agriculturists. We are indebted to the director of agriculture for his plain if unpalatable warning. There appears to be a danger that while the means of securing a preference for our merchandise are being discussed, we may lose the preference now accorded to our men.

MAGNETIC WORK IN INDIA.[1]

THIS relates to the temperature coefficients of horizontal force magnetographs of the Watson pattern belonging to the Indian Survey. The magnet system consists of magnetised iron wires, fixed parallel to one another, in a framework which is attached to a quartz fibre. The upper end of the fibre is attached to a torsion head, by turning which the magnet system is brought nearly perpendicular to the magnetic meridian. With increase of H (horizontal force) the magnet turns until the increased torsion balances the increased magnetic couple, and the position of the magnet is recorded

[1] Survey of India. Professional Papers, 1905. Serial No. 8. Experiments made to determine the Temperature Coefficients of Watson's Magnetographs. By Captain H. A. Denholm Fraser, R.E. Pp 45; with 6 plates and 5 sheets of curves. (Calcutta: Office of the Superintendent of Government Printing, India, 1905.)

photographically by means of a beam of light reflected from a mirror attached to the magnet. With rise of temperature the magnetic moment diminishes slightly, whilst the rigidity of the quartz increases, both causes tending to diminish the angle of torsion and so simulating a fall in H. Measurements made on one of the magnetographs prior to its despatch from England showed a temperature coefficient of approximately 6γ for 1° C. ($1\gamma \equiv 1 \times 10^{-5}$ C.G.S.); but the values obtained in India with different magnet systems and suspensions are mostly about 12.5γ for 1° C. There is, however (see footnote p. 13), no necessary contradiction between these results. The untwisting caused by a given rise of temperature varies as the total angle of torsion, and this varies as the local value of H. But H in India is nearly twice as large as in England. Thus the movement of the magnet due to the change of rigidity in the fibre caused by a rise of 1° is nearly twice as big in India as in England. The memoir discusses the temperature experiments made in India, and the difficulties arising from imperfect temperature control, defects in quartz fibres or in the method of fixing them, and from other causes. The observational data are recorded, and exhibited in the curves, with a detail which is unusual in a printed volume. The values found for the temperature coefficients *in India* are five times larger than those applicable *in England* to some magnetographs of older types with metal suspensions. Even in magnetic chambers under refined temperature control, a small temperature coefficient has advantages which can be fully appreciated only by those experienced in the reduction of magnetic data. Thus the results of the present memoir, though of limited general interest, deserve the attention of instrument makers.

NOTES.

WE regret to see the announcement that Prof. C. J. Joly, F.R.S., Royal Astronomer of Ireland, died on January 4 after a long illness. He was only forty-one years of age.

A BILL which provides for the adoption of the weights and measures of the metric system in all departments of the Government of the United States on July 1, 1908, has been introduced into Congress.

A CENTRAL NEWS message from New York states that by the will of the late Mr. Yerkes the Yerkes Observatory, Chicago, is given the sum of 20,000*l*.

ARRANGEMENTS are being made for the celebration of the twenty-first anniversary of the foundation of the Royal Geographical Society of Australia, Queensland. It is proposed at the end of the current session, in the last week of June, to carry out some appropriate form of commemorative ceremonial to mark the close of the first twenty-one years of activity of the society.

ON Tuesday next, January 16, Prof. E. H. Parker will deliver the first of a course of three lectures at the Royal Institution on impressions of travel in China and the Far East. The Friday evening discourse on January 19 will be delivered by Prof. J. J. Thomson, the subject being some applications of the theory of electric discharge to spectroscopy. On February 2 the discourse will be delivered by Prof. S. P. Thompson on the electric production of nitrates from the atmosphere.

As the signature "H. Weir" occurs so frequently to the illustrations of "Wood's Natural History," which was the popular zoological work of a generation ago, a reference to the death of Mr. Harrison Weir, the well known animal artist, claims a place in our columns. Mr. Weir, who was born at Lewes in 1824, died at his residence at Appledore, Kent, on January 3, at the close of a long period of retirement. Although his portraits of wild animals can scarcely be compared with those of Wolf, they are in most cases—except when drawn from menagerie specimens in poor condition—true to nature and display considerable spirit. Mr. Weir's special *forte* was, however, the portraiture of domesticated poultry, and his work "Our Poultry" has a permanent value as an authentic record of the characteristics of the different breeds at the time it was written. As a judge of poultry and pigeons the deceased artist had a high reputation.

THE first expedition sent out to West Africa by the Liverpool Institute of Commercial Research in the Tropics left England on January 6. The members, who are conducted by Lord Mountmorres, director of the institute, are:—Mr. Kenneth Fisher, chemist; Mr. L. Farmer, botanist; Dr. Slater Jackson, entomologist; and Mr. Coates, commercial adviser. The expedition is proceeding to Dakar, Bathurst, Konakri, and, if possible, to the Cameroons. Being only an experimental expedition, the stay on the west coast will not be of very long duration; in fact, Lord Mountmorres is to return in time to visit the exhibition of rubber at Ceylon in April. But should the results prove satisfactory there is every probability that the institute will dispatch a second expedition to spend a long period in Africa. One of the chief objects of the expedition will be an inquiry into the cultivation of rubber—how to improve the quality of West African rubber in order to bring it up to the same standard as the similar rubber from other colonies, and how to protect and increase the present supply. An effort will also be made to discover new sources of oils, and to find means of increasing the supply by making use of present waste. As regards the study of the prospects of West Africa becoming a fibre-producing country, this branch of the work will include investigation regarding the establishment of hemp, cotton, jute, and ramie growing, and also of new fibres.

WE have received a copy of the report of the Albany Museum for 1904, in which substantial progress is recorded on all sides. It is satisfactory to learn that the proposed cooperation between the museum and the Rhodes University College promises to be of advantage to both institutions. Dr. Schönland, the director of the museum, has already been appointed professor of botany in the college.

MUCH interest attaches to a paper by Mr. Pilgrim in part iii. of the *Records of the Geological Survey of India* for 1905, in which the author describes an elephant skull from the alluvium of the Godaveri valley. This skull belongs to *Elephas namadicus*, of Falconer and Cautley, but the author brings forward evidence which in his opinion proves the identity of that form with the European *E. antiquus*.

OUR knowledge of the land and fresh-water molluscs of Formosa and Japan has been greatly extended by the work of Japanese collectors, the results of which are described by Messrs. Pilsbry and Hirase in the October, 1905, issue of the *Proceedings of the Philadelphia Academy of Sciences*. The collections from Formosa were made in Taiwan, and chiefly consist of land-shells; but although no labour or expense were spared, the number of specimens procured was not so large as anticipated. Nevertheless, out of a total of seventy-one species, twenty-

seven, together with thirteen new subspecies, are described as new. The Japanese collection was chiefly made in the Kyushu and Ryuku chains of islands, and is most satisfactory, as we have now a fair knowledge of the snails of all the larger and of many of the smaller islands.

THE muscles of the jaws and pharynx in dog-fishes and skates form the subject of an illustrated article by Mr. G. E. Marion in the December, 1905, number of the *American Naturalist*. Considering the marked difference in the shape of the two species, the similarity in their muscular system is noteworthy; but, as might have been expected, the skate possesses a few muscles not found in the dog-fish. The deep muscles of the trunk of the former are described for the first time. In another paper Dr. E. N. Transeau discusses the forest-centres of eastern North America, and arrives at the conclusion that there are four such developmental areas, namely, the great conifer forest of the north-east, the deciduous forest of the Ohio basin, the south-eastern coniferous tract, and the insular tropical forest of southern Florida, the centre of which is in the West Indies. The forest-centres correspond with centres of high temperature and humidity.

SOME practical results may perhaps follow a paper contributed by Mr. E. Iwanoff to *Biologisches Centralblatt* of December 15, 1905, on the cause of sterility in zebra-pony hybrids. Sterility appears to attach to the male and not to the female hybrids, although the latter really produce this sterility. For it appears, according to the author's researches, that the spermatozoa are destroyed by leucocytes while within the body-cavity of the female. The female-blood is, in fact, found to contain a substance known as spermatoxin, which acts fatally on the spermatozoa. A similar substance also exists in the blood of female hybrid trout, but as impregnation of the ova takes place outside the body-cavity, no ill results follow to the spermatozoa. It is suggested that in the case of female zebra-hybrids the effects of the spermatoxin should be neutralised by the injection of an anti-spermatoxin serum.

IN the *Biologisches Centralblatt* (December 15, 1905) Prof. Gorjanović-Kramberger discusses the relationships of the race of men whose remains have recently been discovered at Krapina, south of the Styrian frontier. From the examination of these remains it appears that the Krapina race is identical with the one from Neanderthal, Spy, La Naulette, Schipka, &c., for which the name *Homo primigenius* has been proposed. From this primitive type there seems to be a complete transition in cranial characters, through the upper diluvial *H. sapiens fossilis*, to modern man, who occasionally exhibits some of the peculiarities of the ancestral form, such as the absence of the chin prominence and the presence of wrinkles in the enamel of the molars. The pre-diluvial race of Galley (? Gallows) Hill, England, presents a difficulty, since, although this is the oldest, it is at the same time the most modern type. This is explained by the theory of the existence at this early date of two distinct types of mankind, namely, *Homo sapiens fossilis* at Galley (?) Hill, which had attained a relatively high development, and *H. primigenius* at Krapina, Neanderthal, &c., the advance of which may have been prevented by unfavourable conditions of existence.

THE contents of No. 195 of the *Quarterly Journal of Microscopical Science* relate to the anatomy, histology, development, &c., of various groups of invertebrates, and are all of a highly technical nature. Prof. Haswell contributes the first part of a series of papers on the turbellarian worms, dealing in this instance with Heterochærus, while Prof. Carpenter discusses the segmentation and phylogeny of arthropods, and Mr. Hill records his observations on the maturation of the ovum of Alcyonium. Mr. F. C. Sinclair, in the fourth article, alludes to certain points in the anatomy of the myriopods of the family Platydesmidæ; and in the fifth and last Prof. Minchin describes a new sporozoon infesting the mucous membrane of the human nasal septum. At the end of his paper Prof. Carpenter observes that "the more probable conclusion seems to be not that arthropods and polychæte annelids stand to each other in the relation of descendants to ancestors, but that the two groups represent specialised collateral branches from a common stock. My own view is that their common ancestors were microscopic animals, unsegmented, or with comparatively few segments between a broad head-lobe and a narrow tail-somite. The occurrence of the nauplius larva in some members of all the great crustacean groups justifies the phylogenetic importance attached to that form by Müller."

THE position and relations of the abdominal and thoracic viscera of an adult male negro are described and very fully illustrated in a monograph entitled "Topography of the Thorax and Abdomen," by Prof. Potter, just published by the University of Missouri (University of Missouri Studies, Science Series, vol. i., No. 1). The monograph represents a contribution to "descriptive anatomy"—the raw material out of which, when enough has been accumulated, we may hope to build a "scientific anatomy." For several reasons this contribution, though small, is valuable, first, because of the accuracy of the workmanship; secondly, because it deals with a well developed adult man, accidentally suffocated; and thirdly, because it deals with the Negro race, the anatomy of which at the present moment is of the greatest interest. This interest centres round, not what may be called the normal anatomy of that race, but its variations and abnormalities, and to obtain a knowledge of these, records of hundreds of subjects are required. In the subject described by Prof. Potter the cæcum occupies an abnormally high position, a position recalling that seen in the young European child and in the Anthropoid; this, apparently, is a characteristic of the Negro race, for in four subjects recently dissected by the writer of this note a similar condition was observed. Prof. Potter built up the reconstructions and projections shown in the plates of his monograph from a series of twenty-five sections, into which the trunk was divided after being hardened by the injection of a 50 per cent. solution of formaldehyde—a solution employed first by Prof. Jackson. Prof. Potter is to be congratulated on the manner in which he has carried out a laborious task.

SOME figures quoted by the Governor of the Bahamas in his report on the Blue-book of the Bahamas, according to a writer in the *Journal of the Society of Arts*, give an idea of the extent of the sponge fishery business carried on in those waters. There are schooners and sloops with an aggregate tonnage of 5952 engaged in this industry. Attached to the vessels are 2517 open boats, and 5517 men and boys are employed on them. There are also 291 open boats engaged, manned by the owners living on the coasts of several of the out-islands to the number of 445. Disquieting reports as to the exhaustion of the sponge beds and the increasing quantities of small sponges brought to market, which should have been left in the beds to grow to a proper marketable size, recently led to the enactment of a law under which a sponge fisheries board is established with certain powers for the regulation

of the fisheries, and provided with a small annual grant for expenses. Recently the Bight of Abaco was examined, and the result fully confirms the suspicions previously entertained. It is reported that the beds are thickly sown with small sponges which are constantly being gathered by the itinerant fishermen who are continually working over these fields pulling all the sponge they can find without regard to size or quality, in consequence of which there are very few large sponges to be found anywhere. The spongers living in the settlements all round the coast are in sympathy with the movement for protecting the industry against the wasteful methods complained of, and will welcome any reasonable laws for the protection of the young sponge.

THE manurial experiments with cotton in the Leeward Islands detailed by Dr. F. Watts in the *West Indian Bulletin*, vol. vi., No. 3, may be expected to furnish useful information after a trial of some years, when a succession of crops will have emphasised the necessary requirements, and irregularities of climate can be eliminated by averaging results. Dr. Watts recommends the return of the seed to the land, preferably after crushing to express the oil, or as the manure from animals fed on the seed. From the notes by Sir Daniel Morris on grape fruits and shaddocks it is gathered that the larger fruits, referred to *Citrus decumana*, are generally known as pumelows or shaddocks; the smaller fruits assigned to the variety or species *paradisi* may be distinguished as forbidden fruit when round, or as grape fruit having a pyriform shape.

IN *Science*, June 23, 1905, Prof. B. M. Duggar reviews the present-day problems of plant physiology. On the subject of turgor regulation, allusion is made to the investigations of Mayerburg, which tend to show that increased turgor in fungi is caused by the production of osmotic substances within the cell. The writer refers to Moore's work on the organisms found in leguminous tubercles showing that they can assimilate free nitrogen apart from the leguminous plant, to Laurent's experiments on the effects of feeding diœcious plants with different fertilisers, with the results that nitrogen or calcium appeared to increase the number of staminate flowers, and potassium or phosphorus the number of pistillate flowers, and to Blakeslee's identification of homothallic and heterothallic forms of the Mucorineæ.

THE avenues and fruit gardens of Quetta afford a striking testimony to the beneficent results of the British occupation. Writing in the *Indian Forester* (October, 1905), Mr. E. P. Stebbing traces their origin to the foresight of the early administrators, notably General Sir Stanley Edwardes, Sir Hugh Barnes, and Colonel Gaisford. Cuttings of chinar, *Platanus orientalis*, poplars, and willows were brought from Kandahar in 1882. The avenues consist of a mixture of two or more species from the white and black poplars, the reamer, *Populus sp.*, and Euphrates poplars, the Kandahar, *Salix alba*, Kabul, *Salix acmophylla*, and weeping willows, the plane, and a species of American ash. In the gardens some fine old mulberries point to the existence of these trees previous to the occupation by the British; a few specimens of *Populus Euphratica* are found, and walnuts have been planted with satisfactory results.

WE have received a copy of a paper by Dr. Hans Reusch, of Christiania, on the geographical relations of Norway and Sweden. Dr. Reusch deals with the origin and geographical nature of the present frontier between the two countries, and with the density and distribution of population. The paper is reprinted from the *Geographische Zeitschrift*.

PROF. DR. A. OPPEL contributes to the *Deutsche geographische Blatter* a long paper on the forest regions of the middle and upper Mississippi, the prairie lands of Canada, and the New Ontario. The paper is a continuation of Prof. Oppel's previous studies in North America, and is an account of a lengthened journey undertaken during 1904; it contains an immense amount of valuable and interesting information.

THE *Mitteilungen* of the Vienna Geographical Society contain an interesting preliminary report on observations of the altitude of the forest-line in the Austrian Alps, by Prof. R. Marek. The most important general result is that the forest-line sinks continuously from west to east, the rate of fall increasing towards the east, and a difference of 556 metres being recorded within the area investigated—extending through about five degrees of longitude. The average height of the forest-line is about 750 metres below that of the snow-line.

THE third number of the *Abhandlungen* of the Vienna Geographical Society is devoted to a suggestive paper by Dr. Fritz von Kerner. The author discusses the annual march of temperature in the north temperate zone by considering the ratio between the difference between mean monthly values for April and October and the difference between the mean of the hottest and coldest months of the year. Plotting the values of this ratio on a chart, he gets lines to which the name "Thermoisodromes" is given. The distributions revealed in this way, and by further developments of the method, give results of considerable interest in tracing the relations of the "oceanic" and "continental" elements in the climate of the regions covered.

IN a neat art-green canvas cover, Messrs. Burroughs, Wellcome and Co. have issued their well known photographic exposure record and diary for 1906, and the moderate price of 1s. renders it within reach of every photographer. The important features of this pocket-book have been maintained, and the information brought up to date; the light tables, as was the case last year, are printed on perforated leaves, so that each month may be torn out, disclosing the table for the current month opposite the mechanical calculator fixed to the inside of the back cover. The excellent get-up, finish, useful contents, and general handiness of this exposure record and diary have made it a necessary part of a photographic outfit, and this year the photographer who possesses a copy can compete for prizes offered for pictures produced with "tabloid" photographic chemicals.

WITH the December (1905) issue the *Journal of the Franklin Institute* of Philadelphia concludes its 160th volume, and the varied contents show that the high standard that has characterised this journal for eighty years is well maintained. The more important papers in this number are of metallurgical interest. Prof. A. E. Outerbridge gives an able summary of recent scientific progress in metallurgy. Mr. E. Stütz gives a detailed account of the progress made within the past eighteen months in the introduction in the United States of the alumino-thermic process as applied in engineering practice. The progress has been rapid, and the process has proved quite as successful in America as elsewhere for welding and for the repair of castings. Lastly, Mr. Laurance

Addicks discusses the subject of the electrolytic refining of copper, especially from the point of view of the multiple system. The main differences between this system and the series system are in power cost, compactness, and cost of preparing anodes. The fact that large refineries on both systems are being satisfactorily worked bears witness to the close balancing of the advantages and disadvantages in each case, although much more material is refined by the multiple than by the series process.

DURING the night of January 5–6 the central and southern parts of England experienced a very severe gale; the 6h. p.m. observations received at the Meteorological Office on January 5 gave but little indication of the approach of such a severe disturbance, but were sufficient to justify the hoisting of storm signals on all our west coasts. The weather chart for 8h. a.m. on Saturday, January 6, showed that the centre of the storm, which had travelled very rapidly, lay over Lincolnshire, and that strong gales were prevailing in the English Channel and over the southern and eastern counties. In the London district the gusts were very heavy, but it did not experience the full fury which was met with on the coast, although some injury was caused by falling slates and chimneys, and some trees were uprooted. Several wrecks have been reported from the English Channel, and much damage was done to shipping in the Bristol Channel and elsewhere. On Tuesday afternoon (January 9) London and other parts were visited by sharp thunderstorms, accompanied by heavy rain and hail.

A SIXTH edition of the "Hints to Meteorological Observers," prepared under the direction of the council of the Royal Meteorological Society by Mr. W. Marriott, has just been published. The work has been revised and enlarged, and although only consisting of sixty-seven pages, including text, tables, and many illustrations, contains all that is necessary for ordinary normal climatological stations; its conciseness renders it, in our opinion, all the more valuable, and at the present time—the excellent instructions prepared by Mr. Scott for the Meteorological Office being out of print—it is the most useful book of instructions now available for English observers. Among the additions may be mentioned references to the Richard recording instruments (a want to which we recently referred), fuller instructions in connection with phenological observations, and tables for the conversion of anemometrical values from English to French measures, and *vice versâ*. The work would be a desirable acquisition for all meteorological observers, especially those not conversant with the more comprehensive instructions lately published in the French and German languages.

THE Meteorological Committee has issued a useful little pamphlet (12 octavo pages, with charts) on the relation between pressure, temperature, and air circulation over the South Atlantic Ocean. The introductory remarks state that the preparation of monthly wind and other charts occupied the marine department of the Meteorological Office from 1898 to 1904, and were based on no less than 946,000 observations. The charts were published by the hydrographic department of the Admiralty, and at the request of the Meteorological Council Captain Hepworth, the marine superintendent, undertook the preparation of notes which, with a number of small diagrams, are deductions from an examination of the elaborate charts above referred to. They show the variations, the position and intensity of the areas of high pressure, and their relation to the equatorial doldrums, the distribution of gales, fog, &c. The gales appear to reach the South Atlantic in two ways:—(1) they cross South America between 25° S. and Cape Horn, or (2) they avoid the land, and round Cape Horn to the eastward, following the general drift of air and sea surface. Fog is rarely met with north of the thirtieth parallel, except near the land on either side of the ocean. More southward fog may be expected, and is increasingly frequent the higher the latitude reached. This is attributed to the increase of gale frequency with latitude, the cyclonic systems causing rapid fluctuations in air temperature.

THE value for the latent heat of water is the subject of a note by Prof. A. Leduc in the current number of the *Comptes rendus* (January 2). He points out that, in spite of the fundamental importance of this constant, there is a difference of 1 per cent. between the 79·25 of Laprostaye and Deasins, confirmed by Regnault, and the 80·03 of Bunsen. He discusses the possible effect on these figures of the recent work on the variation of the specific heat of water, and shows that even after this is taken into account the difference is still of the same order. Substituting, however, 0·9176 for the density of ice at 0° C. for the 0·91674 found by Bunsen, the 80·03 of the latter investigator becomes 79·15. The larger number for the density of ice is that found by M. Leduc from his own researches, who thus arrives at 79·2 calories at 15° C. as the most probable value for the latent heat of water.

THE third part of "The Primary Arithmetic," edited by Dr. Wm. Briggs, has been published by Mr. W. B. Clive at 6*d*.

A COMPREHENSIVE catalogue of microscopes and accessories has just been issued by Messrs. W. Watson and Sons, High Holborn, W.C. Several of the instruments described and illustrated embody valuable modifications in constructional detail; and the requirements of all classes of workers are met by the two series of objectives—holoscopic and parachromatic—computed by Mr. A. E. Conrady, under whose supervision the whole of Messrs. Watson's optical work is now produced.

Two more subject-lists of works in the library of the Patent Office have been published. The first comprises books on heat and heat-engines (excluding marine engineering), and the second deals with works on aërial navigation and meteorology. Each list consists of two parts, a general alphabet of subject-headings, with entries in chronological order of the works arranged under these headings, and a key, or a summary of these headings shown in class order. These lists may be obtained at the Patent Office, Chancery Lane, W.C., at 6*d*. each.

THE *Bulletin of the Johns Hopkins Hospital* for December, 1905 (xvi., No. 177), contains the second of the Herter lectures by Prof. Hans Meyer on the contributions of pharmacology to physiology, several medical and surgical papers and reports of societies, and some interesting extracts from medical reports by Dr. Wiesenthal, a physician who lived in Baltimore in the latter part of the eighteenth century. The *Bulletin* is an admirable publication, and should be in the hands of all medical practitioners.

THE Science Press of New York has published an account of a research of Prof. E. L. Thorndike on the measurement of twins as the first number of a series of monographs to be known as "Archives of Philosophy, Psychology, and Scientific Methods," which are to be edited by Profs. J. McKeen Cattell and F. J. E. Woodbridge. This monograph presents the results of precise

measurements of fifty pairs of twins from nine to fifteen years old in six mental traits, and their bearing upon the comparative importance of heredity and environment as causes of human differences in intellectual achievement.

FIVE new volumes—Nos. 146 to 150 inclusive—of Ostwald's "Klassiker der exakten Wissenschaften" have been received from the publisher—Mr. W. Engelmann, Leipzig. No. 146 is a paper by Lagrange (1768), translated from the French and edited by Herr E. Netto, the title being "Über die Lösung der unbestimmten Probleme zweiten Grades." J. B. Listing's "Beitrag zur physiologischen Optik," edited by Prof. O. Schwarz, forms No. 147 of the series; and a lecture delivered at Vienna by E. Hering in 1870, "Über das Gedachtnis als eine allgemeine Funktion der organisierten Materie," constitutes No. 148. Under the title "Tastsinn und Gemeingefuhl," an article contributed by Dr. E. H. Weber in 1846 to R. Wagner's "Handwörterbuch der Physiologie" is reprinted with notes by Herr E. Hering. Of particular interest is the reprint (No. 150), edited by Herr A. von Oettingen, of Fraunhofer's paper entitled "Bestimmung des Brechungs- und Farbenzerstreuungs-Vermögens verschiedener Glasarten, in bezug auf die Vervollkommnung achromatischer Fernröhre." This volume contains a plate showing Fraunhofer lines in the solar spectrum, and a picture of the statue of Fraunhofer at Munich.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c* (GIACOBINI).—Observing at Sunderland on December 22, 1905, Mr. Backhouse estimated that the magnitude of comet 1905*c* was approximately 8·3, at 18h. 40m. G.M.T., the observation being made in faint twilight; its diameter he found to be $5\frac{1}{2}'$.

As this comet now rises but about an hour before sunrise, and the apparent distance from the sun is decreasing, it will be scarcely possible for further observations to be made before February, when the comet should again become visible, possibly to the naked eye, in the evening sky.

EPHEMERIS FOR HOLMES'S COMET (1892 III., 1899 II.).—The following search-ephemeris for Holmes's comet is published by Herr H. J. Zwiers in No. 4063 of the *Astronomische Nachrichten*:—

oh. G.M.T.

1906	α (app.) h m s	δ (app.) ° ′ ″
January 11	21 5 39	−18 59 53
,, 13	21 9 45	−18 30 19
,, 15	21 13 51	−18 0 25
,, 17	21 17 57	−17 30 13
,, 21	21 26 7	−16 28 55
,, 25	21 34 15	15 26 26
,, 29	21 42 21	14 22 49

In referring to the ephemeris for comet 1892 V. in these columns last week, that object was designated, by mistake, Holmes's comet. Both bodies were discovered at about the same time, and their periods are very similar, but comet 1892 V. is the faint one discovered by Prof. Barnard, by photography, on October 12, 1892, and was not seen on its return in 1899. A report that it has been detected at the La Plata Observatory is as yet not confirmed.

On the other hand, Holmes's comet was bright enough in 1892 to be observed with the naked eye, and, owing to its eccentric fluctuations in brightness, was described by Prof. Barnard as certainly the most remarkable comet he had ever seen, taking everything into consideration. During an interval of fourteen minutes its diameter, as observed with the 36-inch refractor, increased from $43''·4$ to $47''·9$, and the comet became perceptibly brighter whilst under observation. This comet was first seen on its return in 1899 by Prof. Perrine on June 10 of that year. According to the above ephemeris, the comet should set about ninety minutes after sunset on January 11, but probably its low declination will make it a difficult object to find.

PHOTOGRAPHS OF THE SOLAR GRANULATIONS.—Using the astrographic telescope of the Pulkowa Observatory, Prof. Hansky has obtained some exceedingly interesting photographs of the solar granulations and spots on a large scale. The solar image at the focus of the instrument has a diameter of 3 cm., and by the use of an achromatic double concave lens was enlarged up to 54 cm. (about 21 inches).

The negatives thus obtained were photographically intensified by repeated copying, and details of the granulations became visible. Portions of the strengthened images were then enlarged to such a scale that the solar diameter would be equal to 6 metres (*i.e.* nearly 20 feet).

Copies of the sections thus enlarged are reproduced in the bulletin issued by Prof. Hansky, and on comparing two which were taken with an interval of twenty-five seconds it is seen that the granulations have undergone but little change, although relative movement and changes in brightness are discernible. Photographs taken with an interval of one minute show great changes, and after three minutes only one or two of the granules are recognisable.

The dimensions of the granules vary considerably; the smallest measured had a diameter of about 670 km., the largest about 2000 km.

Prof. Hansky intends to prosecute this research further, and hopes thereby to solve several questions regarding the periodic appearance of granules, the effects of their movements on spots and faculæ, &c.

THE ORBIT OF ξ URSÆ MAJORIS. On many grounds the determination of the correct orbit of the double star ξ Ursæ Majoris is of great interest and importance, and for this reason M. N. E. Nörlund, of Copenhagen, has made a very careful re-investigation of the available data and measurements. About eighteen orbits have been computed previously.

The results of this investigation are given in No. 4064 of the *Astronomische Nachrichten*, and the places computed from the elements obtained are compared with those obtained by many different observers.

For the period M. Nörlund obtains 59·8096 ± 0·06 years, for the time of periastron 1815·957, for the distance $a = 2''·5128$, and for the eccentricity of the orbit $e = 0·4108$.

THE INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE first of the reports referred to below is the first report of the British North Sea Investigations Committee on the International Fisheries Investigations. From time to time during the last three years in which the investigations have been in progress, the International Council has issued the "Bulletin des Resultats," in which are contained the results of the hydrographical and plankton investigations carried out on the periodic cruises; and also the series of "Publications de Circonstance," containing the results of incidental investigations carried out by the various naturalists on the staffs of the different committees. Quite recently, too, the council has issued the third volume of "Rapports et Procès-Verbaux," containing a *résumé* of the results obtained up to the present time. The present volume is, however, the first report which deals exclusively with the results obtained by the British vessels. It is a report to the Fishery Board for Scotland on part of the investigations made by the Scottish staff.

The first three papers in the report, written by Messrs. Helland-Hansen and Robertson, deal with the hydrography of the Færöe-Shetland channel and the adjacent sea regions—the area investigated by the Scottish vessels, H.M.S. *Jackal* and the *Goldseeker*. The principal Scottish line of hydrographical stations extends from the Shetlands to the Færöe Islands, and it is along this line that the changes taking place in the constitution of the sea-water can most easily be observed. It has long been known that the water in this region may be derived from various

[1] "Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Edited by D'Arcy W. Thompson. Pp. vii+618. [Cd. 2612.] (London: H.M. Stationery Office, 1905.) Price 8s. 9*d*. net.

"Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Report No. 2 (Southern Area). Edited by Dr. E. J. Allen. Pp. ix+377. [Cd. 2670.] (London: H.M. Stationery Office, 1905.) Price 8s. 9*d*. net.

sources. We have to deal first of all with the "Gulf Stream," or, as it is now termed, the "Norwegian branch of the European stream," which, originating in the Atlantic Ocean, flows north and east through the Scotland-Shetland and the Færöe-Shetland channels, sometimes reaching as far north as the Murman coast. A second component is water of Arctic origin which enters the Shetland-Færöe channel as an offshoot from the east Icelandic polar stream. Further, the hydrography of these regions is complicated by the occasional presence of water from the Norwegian Sea, from the coasts of Britain, or from the North Sea itself. These various components are traced by observations of their salinity, temperature, and plankton contents. The Norwegian branch of the European stream is shown to exhibit a well marked periodicity. In 1903 the inflow of Atlantic water through the Shetland-Færöe channel decreased from May on, and practically ceased in November, resuming in February of 1904. The southerly polar stream attained its greatest volume in spring; it is apparently able to make its way southwards at all seasons of the year, either as an undercurrent or at the surface. When it is strong it may obstruct the Norwegian stream in the Færöe-Iceland channel, and cause the latter to pass to a greater extent between Scotland and Shetland. These are the principal results attained so far, and they do not add much to our knowledge of the hydrography of these regions; but it must be remembered that they are founded on the results of one year's complete investigations only, and are best to be appreciated at the end of the five years' investigations and when they are considered along with the results attained by the other investigations now in progress.

A most important part of the original scheme of investigations was the discussion of the statistics obtained by the participating States. These matters receive proper attention in the present volume, and Prof. Thompson discusses in a very attractive manner an interesting series of statistics furnished by the Granton Steam Fishing Company, and a similar series of statistics given by the steam trawlers owned by Messrs. Johnston, of Montrose. In each case the average catch per vessel has been calculated, and tables and curves are given showing, in an interesting fashion, the seasonal fluctuations of the fishes under review, which are haddock, whiting, cod, plaice, turbot, and lemon sole. In the case of each fish there are generally two maxima of abundance, one of which is always well marked and the other not so well shown. In the case of the haddock there is, however, a very close correspondence between the catch of this fish and the surface temperature of the sea, a correspondence which Prof. Thompson points out is most probably due to the fact that the great summer fishery for herring takes place at the time when the surface waters of the sea have their greatest temperature, and when the haddock is shoaling to feed on the herring spawn. It is notable that in neither of these cases is there any certain indication of a progressive decrease or increase in the volume of the catches of any of the fishes in question.

Perhaps the most valuable paper in the volume is that contributed by Dr. Fulton in which he elaborates the method of studying the distribution and seasonal fluctuations of fishes first suggested by him in the reports of the Fishery Board for Scotland some years ago. This consists in obtaining accurate records of the catches made by a large number of trawlers, and also information of the places where these catches were made. This plan of obtaining commercial fishery statistics (apart, of course, from the ordinary official figures) was first practised by the Fishery Board, and a considerable number of Aberdeen steam trawlers now regularly provide these figures. The first results of these investigations were published in the annual reports of the Fishery Board, but they are now utilised in connection with the other investigations of the international organisation. The figures are collected by the statistical staff of the Fishery Board at the market in Aberdeen, and are expressed as the quantities of fish caught per vessel per 100 hours' fishing. The North Sea is divided into a number of squares, each of which is bounded by one degree of latitude and two degrees of longitude. All the catches of fish made on each of these squares during each month of the year are then brought together and expressed as the cwts. of fish caught per 100 hours' fishing on each area, and curves are constructed which are superposed, and so show in a very instructive manner the variation in the abundance of each kind of fish from month to month during the year. It is thus shown that there are two maxima of abundance for each fish during the year, one of which corresponds with the spawning time of the species. It is further shown that there is a "complementary or compensating fluctuation" among different species on the same ground, one species becoming abundant as another becomes scarce, so that the sum total of the species on the same ground remains nearly constant during the year.

Other reports in the same volume are those by Dr. T. Scott on the crustacea collected during the seasonal cruises of the *Goldseeker*, and similar papers by Mr. Clark on the other plankton collections. Prof. Thompson also contributes a translation of a paper by Sandstrom and Helland-Hansen on the mathematical investigation of ocean currents. It is regrettable that the fishery experiments of the *Goldseeker* have not been described and summarised in this volume, but these will no doubt be the subject of a future report. One must not omit to mention the beautifully engraved charts of the North Sea which illustrate the paper on the trawling statistics of Aberdeen.

The second of the reports under notice deals with the part of the international investigations which was entrusted to the Marine Biological Association, and gives an account of the researches carried out in the southern part of the North Sea and in the English Channel. In some respects this report is complementary to that issued by the Scottish Fishery Board; in the latter special attention is directed to the results of the hydrographical work and to statistical studies, while fishery investigations are not reported upon. In the English Blue-book, on the other hand, the bulk of the space is devoted to an account of the fishery investigations. The hydrographical researches, which are reported only by Mr. D. Matthews, were carried out in a somewhat limited area, but are of very great interest. It is shown that the water in the English Channel is derived from two main sources:—(1) high salinity water (35·6 parts per thousand and upwards), which enters the Channel as a current flowing in a northerly direction from the Bay of Biscay; and (2) low salinity water, entering the Channel as a southerly current from the Irish Sea and the Bristol Channel. The limits of these contributing currents are well shown on the hydrographical charts, where the lighter water is seen to be present mainly to the west of a line running roughly south from the Scilly Isles; while the denser water forms a tongue of variable magnitude, according to the season, entering the Channel in a north-easterly direction near Ushant. Within the Channel itself the hydrographical conditions are very complex; a general drift of surface water from west to east has been observed, but the distribution of the high and low salinity waters in the Channel is far from simple. Generally speaking, the main source of the water entering the Channel during the summer and early autumn is the Irish Sea, while during the rest of the year the denser water of the Bay predominates. The observations have been made for a year only, so that the very important question whether or not these changes in the origin of the contributing waters are periodic remains still to be investigated.

Perhaps the most interesting part of the report is that by Mr. Garstang dealing with the results of experiments on the marking and liberation of living plaice and other fishes. These experiments have now been carried out by most of the national research staffs, and are yielding results which are very instructive from the point of view of the growth and migrations of the plaice especially. The mark used is a brass label bearing a number, and fastened to the body of the fish by means of a silver wire passing through the body and attached to the other side by a bone button. This mark can be attached to the fish without permanent injury to the latter, and apparently without any retardation of growth or other disturbance of the normal habits of the fish. The results are recorded in Mr. Garstang's report, and are illustrated by means of synoptical charts which show the principal migrations made by the fishes which have been recovered. Up to the end

of 1903, 1463 plaice were marked in this way, and of these 287, or 19 per cent., have been returned to the association. The general facts regarding migrations brought out by these experiments are these:—the smaller fishes do not appear to migrate to any considerable extent, and the larger the fish is the more extensive are its migrations. In some cases the distance travelled has been very considerable; thus one plaice is shown to have travelled a distance of 175 miles in about six weeks, and another travelled a distance of 210 sea-miles in eight months. The general trend of the migrations has been in a southerly direction during the winter and in a northerly one during the summer. As a rule, the smaller fishes travel from the shallow water "nurseries" to the deeper waters during the earlier period of their life.

A most attractive part of these migration experiments is the question of the transplantation, on a commercial scale, of fishes from overcrowded grounds to those grounds where the conditions for favourable growth are present, but where there is not already an abundant population of the kind of fish in question. An interesting account of such an experiment is given by Mr. Garstang. Although the conditions of nutrition on the well known Dogger Bank are apparently very favourable for plaice, yet, on account of its comparatively isolated situation, this area contains a population of plaice which is probably far below that which it is able to support. Accordingly, more than 1000 small plaice were transplanted from certain in-shore grounds to the Dogger Bank, and in the course of a year more than 40 per cent. of these fishes were re-captured from the Bank itself and the slopes around it. It is shown that the growth-rate of these fishes was far in excess of that of those living on the ordinary in-shore fishing grounds, and the question of the practicability of the wholesale transplantation of small plaice from the shallow-water fishing grounds to such grounds as the Dogger Bank is carefully discussed. It is very questionable, however, whether transplantation operations on such a scale could be arranged at all so as to be successful.

The remainder of the report deals with the records of the fishing experiments and with various other matters. Dr. Wallace presents a report on the growth-rate of the plaice based on the examination of the annual growth-rings in the otoliths. Mr. Todd contributes a lengthy account of his examination of the contents of the stomachs of a very great number of fishes caught in the course of the trawling operations, and draws some interesting conclusions on the food of the various species dealt with. Lastly, Mr. Gough reports on the occurrence and distribution of the plankton of the English Channel during 1903.

The records of the trawling experiments contain a large mass of observations which are capable of much further analysis than has been attempted in the present report. 84,000 measurements of individual fishes have been made in the North Sea and in in-shore waters, and when these are considered along with the records of the hauls made by the Scottish Fishery Board's exploring steamer abundant material should be forthcoming for a discussion of the distribution of fishes in the North Sea according to their age and size. Altogether the North Sea Fisheries Investigation Committee is to be congratulated on the publication of these reports.

J. JOHNSTONE.

INSECT PESTS OF THE COTTON PLANT.[1]

THESE two reports may be taken as object-lessons of the way in which such economic investigations should be carried out by the agricultural departments of progressive countries.

The wide area over which cotton cultivation is spreading makes the investigation of its enemies in those regions where it has long been cultivated of great value. Such researches guide us in investigating new enemies, and they prepare us to guard against the introduction of pests with foreign seed.

The authors of the report on the bollworm have produced a work of great value to all cotton planters. The pest is recorded from North and South America, the West Indies, Europe, many parts of India, China, and Japan, the East Indies, Australia and New Zealand, and even in the Gilbert and Navigator Islands. Of particular interest is the record from the Sudan and British East Africa, but it is not recorded as attacking cotton there. Besides infesting cotton, it is equally destructive to corn, and the authors tabulate seventy other food plants, distributed over twenty-one natural orders.

There are excellent plates showing ova, larvæ damaging the buds, tassels and ears of sweet-corn as well as cotton. The injuries are explained, and it is clearly pointed out how the cotton becomes infested by the third and fourth

FIG. 1.—Work of Bollworm in Cotton Bolls. 1, Bollworm eating into a half-grown cotton boll; 2, bollworm boring into a full-sized cotton boll; 3, full-grown bollworm and its work in large cotton boll; 4, cotton boll only partially destroyed by bollworm, two "locks" open, the others destroyed (original).

generations of larvæ, the previous ones feeding upon the corn.

The summary given of the life-history shows that the moth may lay from 500 to 3000 eggs, especially upon the "silks" of corn and the "squares" of cotton. During warm weather they hatch in two or three days. In spring the young larvæ eat the buds, later the silks and tassels of the corn; in August and September they attack the cotton. They bore directly into the "squares" and "bolls," and destroy the latter. Maturity is reached in two weeks; they then enter the soil to pupate. Detailed descriptions are given of all the stages, the effects of climate, and variations in colour. Nothing definite is shown to account for the great variation seen in the larvæ.

[1] "The Cotton Bollworm." By A. L. Quaintance and C. T. Brues. U.S. Department of Agriculture, Bureau of Entomology, *Bull.* 50. Pp. 155+plates xxv+figs. 27. (1905.)
"The Mexican Cotton Boll Weevil." By W. D. Hunter and W. E. Hinds. *Idem, Bull.* 51. Pp. 181+plates xxiii+figs. 8. (1905.)

Amongst predaceous enemies is mentioned a Chrysopa which feeds upon eggs and young larvæ. Wasps appear to do most good. Numerous parasites are also described; one, *Trichogramma pretiosa*, a small hymenopteron, attacks the eggs, others the larvæ; but from what we

FIG. 2.—Various Results of Larval Work. 24, Leaf fed on extensively by weevils in confinement; 25, full-grown larva in square ready to bloom; 26, full-grown larva in square of usual size; 27, larva full-grown, ovary in square entirely destroyed; 28, larva full grown, ovary untouched—all reduced (original).

gather from the report man cannot expect much help from these "natural checks." Remedial and preventive cultural measures are thus fully explained.

The Mexican cotton boll weevil is luckily confined to the United States, Mexico, Cuba, and Guatemala. The authors have been unable to verify the reports that it has been found in Africa or Brazil. If a cotton weevil occurs in the former country it is probably another species, as we see is the case in the Philippine Islands.

The Mexican weevil has the unique record of developing in less than twenty years from an obscure species into a great pest. The authors ably describe its life-history and destructive habits in Texas and elsewhere. In the summary of the life-history it is stated that the egg is deposited by the female in a cavity formed by eating into a square or boll. The egg hatches in a few days, and the footless grub begins to feed, making a larger chamber for itself as it grows. The pupa also occurs in the boll. It is important to note that no other food than cotton has been found.

Some interesting experiments are recorded which tend to show that the weevils are not able to locate their food by smell.

Another series of experiments showed that the weevils prefer Egyptian cotton (Mit Afifi) to the American upland cotton.

Their capacity for reproduction seems appalling, judging from the table given showing the annual progeny of one pair of hibernating weevils, which amounts to 12,755,100!

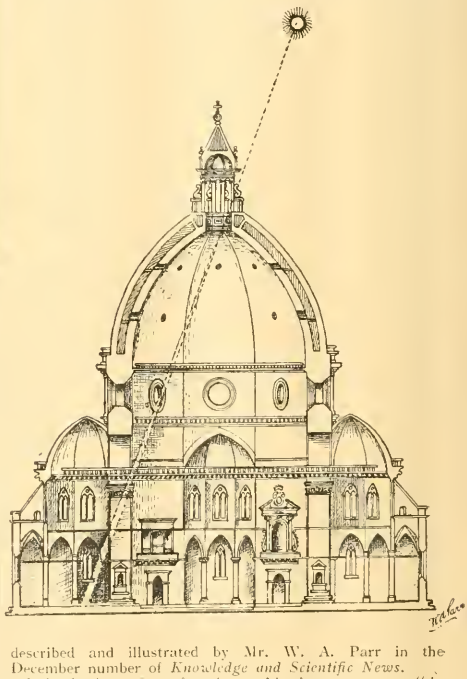
The beetles hibernate in many places, as in infected bolls and stalks, and it is shown that the early destruction of the stalks in the fall is the most effective way to reduce the pest.

Dissemination takes place in cotton in bales and that sent for "ginning." Shipments of seeds are said to be almost certain to carry weevils if coming from infested areas. The report also shows another important point, namely, that the pilosity of the plant affects the progress of the weevil. Parasites do not seem to be of much use. Doubt is cast by the authors upon the benefit of *Pediculoides ventricosus*. Mention is also made of the possible use of the Mexican ants (*Ectotomma tuberculata*), &c. Of great importance to those who import seed is the result showing that bisulphide of carbon is the best substance to clean the seed.

FRED. V. THEOBALD.

THE GREAT GNOMON OF FLORENCE CATHEDRAL.

ALTHOUGH numerous Christian churches are either oriented or adorned with reference to some astronomical phenomenon, there are few of such direct interest to the astronomer as the magnificent cathedral of Florence, which contains a gigantic contrivance for determining the advent of the summer solstice. We refer to the famous gnomon, placed in the dome of that cathedral by Paolo Toscanelli about the middle of the fifteenth century, and



described and illustrated by Mr. W. A. Parr in the December number of *Knowledge and Scientific News*.

Lalande in 1765 referred to this instrument as "la méridienne que l'on voit dans la Cathédrale de Florence est le plus grand monument d'Astronomie qu'il y ait au

monde," but at that time the astronomical significance of the Egyptian temples, or even of our own less pretentious Stonehenge, had not been demonstrated.

Sir Norman Lockyer has shown in "The Dawn of Astronomy" that the enormous edifice at Karnak, the temple of Amen-Ra, was oriented for a similar purpose, so that at the setting of the sun on the day of the solstice, and at that time only, the solar beam flashed along the darkened axis of the temple, some 500 yards long, and illuminated the "holy of holies" wherein the priest was ready to fulfil the rites of "the Manifestation of Ra." He has also shown that Stonehenge was erected for a similar purpose about the year 1680 B.C., but in this case the limb of the actual (rising) sun was observed, the avenue simply forming the sight-line to the point on the horizon where the sun-god would make his first appearance on the day of the solstice.

But although since Lalande made the statement quoted above it has been shown that the gnomon at Florence is not the *largest* monument to astronomy the world has ever seen, it is still one of the most interesting. As may be gathered from the accompanying illustration, the sunlight, passing through the southern window of the lantern, falls on to the gnomon, which is built into the marble sill of the window, and thence, through a circular orifice, on to a "solstitial" marble slab let into the cathedral floor some 300 feet below, where its correct position at the solstice is marked, or was intended to be marked.

This immense meridian instrument was probably designed by Toscanelli in order to provide exact observations for the correction of the Alphonsine tables which were then in use, but which represented very inadequately the solar motion, more especially as regards the true length of the tropical year. Whether he also intended to observe the variation of the obliquity of the ecliptic is a much discussed question, but it does not seem improbable. In either case his gnomon, probably built only in 1468 A.D., could not answer this purpose anything like so surely as do the Amen-Ra and Stonehenge structures, built many centuries earlier. Apart from this reason, the facts that the gnomon itself has been removed from its original position, and that the solstitial circle on the cathedral floor has been found to be erroneously placed, have destroyed for ever the instrument's utility in this direction. It has been used, however, in order to detect any possible movement in the fabric of the cathedral, but, to the credit of Brunelleschi, who built the structure, no such movement has ever been demonstrated.

In the light of the recent articles in NATURE (p. 153) concerning the fires, &c., by which the ancient British festivals were celebrated, it is interesting to note that Mr. Parr considers that the great display of fireworks, which to the modern Florentine forms the chief attraction of the Midsummer Day festival, is simply the analogue of the "St. John's Fires" kindled in former times to celebrate the advent of the summer solstice. On that day huge crowds of Florentines flock to the cathedral in order to celebrate the festival of their patron saint, St. Giovanni, and at night the great dome itself is illuminated.

W. E. R.

THE TRAINING OF THE BODY AND MIND.

FOR years the London County Council has arranged a conference of teachers during January, and this time it was held on January 4–6 at the Medical Examination Hall on the Victoria Embankment. In the old days, when the County Council was only interested in technical instruction, the meetings were devoted to the interests of science teachers more particularly, but now that general education has been added to the responsibilities of the body that governs London, matters appertaining to all kinds of teaching are considered at the conferences.

The first day's work was, however, devoted to a subject that affects all education, namely, that training of the body which is correlated with the proper development of the mind. Mr. A. J. Shepheard (vice-chairman of the education committee of the London County Council), who opened the conference, urged the importance of a complete education, and Colonel Malcolm Fox (inspector of physical training to the Board of Education) read the first paper, which dealt more particularly with physical training in elementary schools. He began with a brief sketch of the history of gymnastics and physical culture in general, though going no further back than the days of ancient Greece, which, in its beautifully symmetrical statues, has left us undoubted evidence that it had little to learn in the science of training the body.

Colonel Fox went on to say that the Greeks practised little of what we understand as gymnastics, and attained their object by such exercises as riding, dancing, leaping, or running, and he pointed out that the trend of gymnastic opinion is again turning strongly in the same direction. As the power of Greece declined, her universal physical culture ceased to be national, and passed to the individual whose business it was to afford entertainment by exhibiting his prowess in the arena. When the remnants of greatness passed to Rome, no physical training became general, as the many contented themselves with the excitement afforded by the efforts of the trained few. It is true that the "sporting nobles" of the famous Tenth Legion used from time to time to descend into the arena, competing with some favourite team in the chariot races, or matching their skill with sword and shield against the net and trident. This action was, however, exceptional, and the period bears the picture of a vast concourse hanging with fevered excitement on every stroke of sword or cast of net—spectators at a game that they themselves had little ability or desire to play. To find a modern parallel to such a scene we have unfortunately not far to seek.

After touching on the absence of any definite system of gymnastics also in the middle ages, and the recommendation of exercises as a cure for certain complaints as early as the sixteenth century, the reader of the paper traced the use of systems in France, in Germany, where gymnastics were first used in an educational sense, in Switzerland, where Pestalozzi adopted them, and in Sweden, where between 1776 and 1839 Ling was the pioneer in classifying gymnastics into groups and arranging them scientifically in accordance with the needs of the human body.

Colonel Fox described how, after an interregnum, revivals of physical training took place, and stated that under the tests of modern physiological knowledge the Swedish system of Ling stands out preeminently above all others. He further dwelt on the mild and gradual work in its early stages, on its effects upon the body and success in other countries, as well as its educational results. These admit of no immediately apparent proof, but they do exist, as a few weeks' trial of them will most assuredly show. Psychology, Coloned Fox said, with our limited knowledge, allows of deductions only from experience, and the latter is unanimous that the educational results claimed by Ling are gained, and that the qualities of courage, obedience, decision, alertness, concentration of thought, and self-confidence are not confined to the hour or two of the gymnastic lesson, but become part and parcel of the child's nature.

After speaking of methods, duration of lessons, the dearth of male teachers, and matters of interest to elementary and other teachers, Colonel Fox concluded by quoting figures from the report of a Royal Commission on Physical Education in Scotland. Of 600 children examined in Aberdeen, only 326 were found to be in good health, while of the same number in Edinburgh but 171 were found to be sound.

The next paper was by Mr. W. Langbridge (headmaster of Wolverley Street School, Bethnal Green), and dealt with exercises which can with advantage be performed in classrooms and afford a relief to ordinary lessons during which activities are constrained.

In the afternoon Sir Lauder Brunton took the chair, and discussed education in connection with the threefold character of man. At first, he said, moral training was provided, and churches and cathedrals were built long before the people could read or write; then mental culture was considered, and became very general; and, lastly, it was being recognised that the condition of the body had considerable effect upon the morals and the mind, so that a physical training was also considered necessary. He gave some interesting instances to show how character

and habits had been entirely altered by accidents to the brain, and said that while Newton was physically weak, Young, who was his superior even in mental capacity, was a circus rider, and could perform almost any bodily feat.

Sir Lauder Brunton spoke of the need to train the higher inhibitory nerve centres, and of the possibility of keeping in order involuntary movements. He said that children could not do physical exercises unless they were properly fed, and urged that no damage must be done by over-exertion. Medical inspection was desirable, but teachers, he thought, could easily learn to recognise the signs of danger.

Dr. Kerr (medical adviser to the London County Council Education Committee) took as his subject the position of physical exercises in the infant department of the elementary school. He pointed out that while certain of the nerve cells in the infant were quickly matured, and this was especially so with those dealing with behaviour that has been hereditary for long periods, other nerve cells were still capable of being acted upon for a considerable time. In this state they were very susceptible to fatigue, and frequent periods of rest were needed in which the waste products from action could be removed. He advised the use of physical exercises for infants, and maintained that no great perfection of detail ought to be looked for.

Of a different character was Mrs. Kimmins's paper on the educational value of organised play, for it was a graphic account of the way in which most of the benefits claimed as coming from physical training could be gained out of school, and in the particular case described, away from it.

All the speakers upon physical exercises agreed that these were only complementary to games; and in the last paper of the day Miss Kingston (organising instructor of physical exercises of the London County Council) discussed the interrelation of drill and organised play.

It should be pointed out that all concerned were most anxious that the word drill should not be used, as it called up in the mind military drill, something quite different from the exercises and unfitted for children. There was also considerable unanimity as regards the need for the pupils to do the work for its own sake and as a pleasure, and not as a task. Sir Lauder Brunton was most emphatic on this point, as was also Dr. Kerr. The Rev. Stuart Headlam, a member of the old School Board, in the discussion objected to things being made too pleasant, but it had been pointed out that even games pall if they are too much organised, and their interest and freshness thus lost.

There is no doubt but that as true nature-study should properly put the child so far as possible into the same mental relation with its surroundings that primitive man enjoyed, so physical exercises adopted in a pleasurable way should counteract the baneful effects of civilisation, as Dr. Kerr pointed out on Thursday, and, one may add, give our young people the bodily advantages of their remote ancestors.

As on previous occasions, Mr. C. A. Buckmaster and Dr. Kimmins (chief inspectors, respectively, to the Board of Education and the London County Council, education committee) organised the conference in a remarkably successful manner. WILFRED MARK WEBB.

COLOUR VISION IN THE PERIPHERAL RETINA.[1]

THE results of a research into the nature of colour vision in the peripheral portions of the retina, carried on by Mr. Baird during the years 1903 and 1904 in the psychological laboratory of Cornell University, have lately been published in a pamphlet. The work so carefully done by Hess and the numerous papers by him on this subject have received fairly general acceptance, and in the present work Mr. Baird confirms most of Hess's conclusions. The reason he gives for the publication of a pamphlet which contains little new work of any great value is that Hellpach, in his research on the nature of colour sensation in the peripheral retina, had arrived at conclusions which controverted many of the statements of earlier observers, and it was deemed advisable to repeat Hellpach's work in order to see whether there might not be some fallacy in the method. Mr. Baird's work practically in every respect confirms that of Hess, and we think there is little doubt that his explanation of the confusing results obtained by Hellpach is correct, that Hellpach did not allow sufficient time to elapse between successive stimulations, and consequently the colour sensation due to the immediate stimulation was partly modified by a latent after image of the preceding stimulus.

In standardising his colours, Mr. Baird arrived at practically the same results as Hess. The red used transmitted no part of the visible spectrum, and Hess, in order to get a stable red, had to mix it with a certain amount of blue. The yellow, green, and blue used corresponded fairly exactly with Hess's stable colours.

It is when we come to the problem of equating the white values of the different colours that the greatest difficulty is met with. We must confess to a strong suspicion of the value of Mr. Baird's method. He is engaged on a research on the nature of colour vision in the peripheral retina, and in the determination of his standards he utilises the very portion of the retina which he is subsequently going to investigate. We quite allow that there is no satisfactory method of equating white values at present known, but we certainly think that Mr. Baird has chosen the least satisfactory of all. Probably the best method of photometry available at present depends on the flicker phenomenon, and for Mr. Baird's purpose we feel sure it would have been much more suitable and much more scientific than the method he did adopt.

In other respects the work has evidently been carefully done, and though, as we have said, it adds little that is new to our stock of knowledge, it is of value in that it confirms much of the work of previous observers.

[1] "The Colour Sensitivity of the Peripheral Retina." By John Wallace Baird. Pp. 80. (Published by the Carnegie Institution of Washington, 1905.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. R. A. LEHFELDT, professor of physics at the East London College, has been appointed to the chair of physics in the Transvaal Technical Institute, Johannesburg.

THE Corporation of Glasgow has resolved to make a grant of 10,000*l.* to the building fund of the Glasgow and West of Scotland Technical College, from the common good of the city.

IT is satisfactory to find a committee of the Classical Association reporting that "in view of the legitimate claims of other subjects the amount of time devoted to the classics on the classical side of boys' public schools is as great as can reasonably be expected." From the report which was presented at a meeting of the association on Saturday last, it appears that in the highest form on the classical side in the larger public schools a considerable amount of specialisation is allowed to many boys. In the other forms the time devoted to Greek and Latin together generally amounts to about one-half of the whole number of school hours. In the smaller public schools there is less specialisation in the highest form. The proportion of time given in school to classics increases from somewhat less than one-third in the lowest form in which both Greek and Latin are studied to slightly less than two-thirds in the highest form. The committee suggested that time and effort might be saved and better results obtained by certain changes in the method of teaching Greek; and in the discussion upon the resolutions put forward with this end in view, we are glad to see that Canon Lyttelton, headmaster of Eton, pointed out that the time gained by the adoption of the plan proposed "might well be given to instruction in some of the elements of scientific knowledge rather than to history and archæology. Let them hold out a helping hand to their scientific colleagues and meet them half-way. There had been too little conciliation between the two sections of teachers. Then we might hope to correlate these great subjects, which were too important to abandon, but which we had not yet enabled to live in amity together."

THE organisers of the North of England Education Conference, held this year at Newcastle-upon-Tyne on January 5 and 6, had to struggle with the fact that almost all persons and bodies who were desirous of conferring together had their hands full with the difficulties of primary education and its immediate continuations. The conference was well attended by between two and three hundred members drawn chiefly from the education committees of the county councils, the permanent officials of such committees, and schoolmasters and mistresses, and their interest was almost entirely directed to the problems called into existence by the duties now thrown upon the education committees. Not a word was said as to higher education, very little as to secondary education in any form, and, it may be added, scarcely a word as to the religious difficulty. The tone of the conference was distinctly optimistic, and it was the general opinion that if the councils were less encumbered by intervention of the Board of Education, and deputed more of their own work to persons in each locality, the difficulties that have declared themselves would work themselves out. It was encouraging to see so much determination to cope with the questions, in spite of the heavy tax of time thrown upon the education committees, and it is very clear from the local patriotism exhibited that the councils will not ultimately rest content with perfecting a primary system. It is, however, a question of pounds, shillings, and pence, and so long as the councils are left without other resources than the rates it is clear that improvements must wait a long time.

THE December, 1905, issue of the *Bulletin of the Massachusetts Institute of Technology* comprises, as usual, a list of the staff and students of the institute, with a statement of the requirements for admission, a full description of the courses of instruction, and an account of the Lowell School for Industrial Foremen. It is interesting to note that the institute offers summer instruction during the months of June and July, supplementing the work of the regular school year. Summer courses are undertaken primarily for the benefit, first, of those who wish to distribute their work over a larger portion of the year, or to gain more time for advanced work; and, secondly, of those who, through illness or other causes, have deficiencies to make up. Moreover, to bring students into closer relations with the practical side of their professions, professional summer schools are held in the departments of civil engineering, mining engineering and metallurgy, architecture, chemistry, and geology. The students, accompanied by instructors, give their time to field-work, or visit and report on mines and industrial establishments. The Lowell School for Industrial Foremen is a free evening school which includes, at present, mechanical and electrical courses extending over two years. These courses are intended to bring the systematic study of applied science within the reach of young men who are following industrial pursuits and desire to fit themselves for higher positions, but are unable to attend courses during the day. This number of the Bulletin, with its 408 pages, provides abundant evidence of the excellent work being accomplished by this widely known institute.

THE annual meeting of the Geographical Association was held on January 5, when the report for 1905 was adopted. The report shows that the total membership of the association is 503, including teachers of every grade, school inspectors, and others interested in geographical education. An important advance was made during the year by the formation of local branches. This is a valuable expansion of the work of the association, enabling members to meet at more frequent intervals, to discuss the advantages presented by their own district for teaching geography, permitting combination in excursions and cooperation in the accumulation of lantern-slides and other materials necessary for good teaching. The geographical exhibits collected by the association in 1904 were on view during the year at Liverpool, Huddersfield, Bedford, and Oxford. Part of the exhibits were lent to Felsted School for a local exhibition. The exhibition is now being broken up, and exhibits lent to the association returned. Dr. G. R. Parkin, secretary of the Rhodes Scholarship Trust, who was in the chair, dealt in his address with the general question of geography. In war, he said, geography is of the greatest importance. If our commanders at the battle of Colenso had possessed an elementary knowledge of the geography of the country thousands of precious lives might have been saved. In a nation like ours, which may any day find it necessary to send an expedition to a frontier place in India or to some corner of Africa, the intimate study of geography is an essential condition of national safety and honour. In commerce, too, geography is everything. Only last year the great cotton districts of Lancashire began to realise that the supplies of cotton were not sufficient for the demand, and Sir Alfred Jones organised a company to discover what places under the British flag are suitable for raising cotton. This is largely a geographical work which a great commercial country like ours should be carrying on as a Government measure. As the great workshop of the world, which almost requires the world from which to draw raw material and food, no nation ought to know so much about geography as ourselves, and yet up to the last eight or ten years hardly a subject has been shown so little consideration.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, December 12, 1905.—Mr. Howard Saunders, vice-president, in the chair.—*Exhibitions.*—Twelve enlarged photographs of whales taken at the fin-whaling factories in east Finmarken in 1883–89: A. H. **Cocks.** The species represented were *Megaptera longimana, Balaenoptera sibboldii, B. musculus,* and *B. borealis.*

The tail-vertebræ of a dormouse of the genus Eliomys, which showed the phenomenon, hitherto unrecorded among Mammalia, of the regeneration of a bony structure in case of accident: Oldfield **Thomas.** The caudal vertebra, in this case the twelfth, which had been originally broken across, had grown out into a slender styliform appendix 15 mm. in length and rather less than 1 mm. in diameter, the normal vertebræ of this part of the tail measuring about 6×2 mm. On further search two other specimens exhibiting the same structure had been found, and it appeared, therefore, that dormice, like lizards, were able partly to regenerate their tails, when these important balancing-organs got accidentally broken.—Microscopic sections of the skeletal tube found in the restored tail of one of the dormice (Graphiurus) exhibited by Mr. Thomas: Dr. W. G. **Ridewood.** The wall was made up of close-set lamellæ, producing in a transverse section a fine concentric striation. Lacunæ with numerous branching canaliculi were disposed regularly in relation with the concentric striations, and the general effect was that presented by a transverse section of the humerus or femur of a frog. Internally to the bony layers, and contiguous with the central jelly, was a moderately thick layer, which was clear, homogeneous, and highly refractive. Dr. Ridewood also exhibited, by way of contrast, slides of the skeleton of the restored tail of an iguana lizard, the skeletal tube in this case being composed of calcified fibro-cartilage and not of bone.—*Papers.*—Observations and experiments on the habits and reactions of crabs bearing sea-anemones in their claws: Prof. J. E. **Duerden.**—Notes on a large collection of snakes made by Mr. Alan Owston in Japan and the Loo Choo Islands: Captain F. **Wall.**—A collection of South Australian spiders of the family Lycosidæ contained in the museum at Adelaide: H. R. **Hogg.** Thirteen species were remarked upon, ten of which were described as new.—A collection of mammals obtained by Colonel A. C. Bailward during a shooting trip through Persia and Armenia during the past summer, and presented to the National Museum: Oldfield **Thomas.** Thirty-one species were enumerated, and special attention was directed to the discovery of Calomyscus, a primitive murine, the only ally of which, amongst recent forms, was the North American Peromyscus.—The colour-variation of the beetle *Gonioctena variabilis*: L. **Doncaster.** The material on which the paper was based was collected almost entirely at Granada, and the author found that, although the insect was extraordinarily variable, when a large collection was examined the beetles could be classified into two chief

groups with but few intermediate forms.—Two new species of worms, one a Pontodrilus from the shores of the Red Sea, and the other an Enchytraeid of the genus Henlea from India, which was destructive to the eggs of the locust: F. E. **Beddard.**—Two species of decapod Crustacea, a crab and a prawn, collected by Dr. R. Hanitsch, of Singapore, from a small artificial fresh-water pool on Christmas Island: Dr. J. G. **de Man.** The interest of their occurrence lies in the fact that previous to the construction of the reservoir, a few years ago, there seems to have been no possible habitat for these animals on the island, and they must have been introduced since that time, perhaps by migration from the sea. The crab was referred to *Ptychognathus pusillus*, a species described by Heller from the Nicobar Islands forty years ago, and not since found. The prawn was made the type of a new variety of *Palaemon lar*, both the variety and the typical form having a wide distribution in countries bordering the Indian Ocean.—Results of experiments made in connection with the heredity of webbed feet in pigeons: R. **Staples-Browne.**—New and rare British Oribatidæ: C. **Warburton** and N. D. F. **Pearce.** Eleven species were remarked upon, of which seven were described as new to science, and two were recorded for the first time as being British. The nymph of *Serrarius microcephalus* was described for the first time, and it was pointed out that *Gustavia sol* of Kramer was a nymph of an unknown species of Serrarius.

Royal Meteorological Society, December 20, 1905.—Mr. R. Bentley, president, in the chair.—Attempt to fly kites for meteorological purposes from the mission ship attached to a deep-sea fishing fleet in the North Sea: G. C. **Simpson.** These observations, which were made in July and August last, were carried out on behalf of the joint kite committee of the Royal Meteorological Society and of the British Association. By the kindness of the Royal National Mission to Deep-sea Fishermen, the kites were flown from the deck of the mission ship *Queen Alexandra* attached to the Red Cross Fleet. Owing to the vessel being almost continuously employed in trawling, the opportunities for flying kites were very limited; nevertheless, Mr. Simpson was able to secure eight ascents during the time he was on board the vessel, and he now gave the results obtained. The greatest height reached was 5800 feet.—Method of flying kites in Barbados in April and May last year: C. J. P. **Cave.** Mr. W. H. Dines, who had examined the records, said that the humidity traces show generally a value of about 60 per cent. at the surface, rising to 80–90 per cent. at heights from 1000 feet to 2000 feet, and then falling off again in some cases to 50 per cent. or less as the height increases. These values are lower than might have been expected over a tropical ocean. The increase is of the ordinary kind, but the maximum value occurs at a far lower elevation than is the case in Europe. It is probable that the relative humidity forms an extremely accurate index to the vertical circulation, a low humidity indicating a descending current of air, and so it may be inferred that there is some settling down of the atmosphere over the region of the smaller west Indian islands in April and May.—Temperature observations during the partial solar eclipse, August 30, 1905: W. H. **Dines.**—Comparison between Glaisher's factors and Ferrel's psychrometric formula: J. R. **Sutton.**—A rapid method of finding the elastic force of aqueous vapour, &c., from dry and wet bulb thermometer readings: J. **Ball.**

Chemical Society, December 21, 1905.—Prof. R. Meldola, F.R.S., president, in the chair.—Azo-derivatives from methyl-α-naphthocoumarin: J. T. **Hewitt** and H. V. **Mitchell.** Several of these derivatives are described; the most interesting is p-*nitrobenzeneazomethylnaphthocoumarin*, which gives an intense blue coloration in alkaline solution.—The preparation and reactions of benzoyl nitrate: F. E. **Francis.** Benzoyl nitrate is formed by the interaction of benzoyl chloride with silver nitrate at low temperatures. It is a light yellow oil which, if carefully warmed, decomposes into benzoic anhydride and oxides of nitrogen, but if heated quickly explodes.—The supposed identity of dihydrolaurolene and of dihydro*iso*laurolene with 1 : 1-dimethylhexahydrobenzene: A. W. **Crossley** and N. **Renouf.** Zelinsky and Lepeschkin supposed that these three substances were identical, but this is not the case.—The diazo-derivatives of 1 : 5- and 1 : 8-benzenesulphonylnaphthalenediamines: G. T. **Morgan** and F. M. G. **Micklethwait.**—Further experiments on a new method of determining molecular weights: P. **Blackman.**—Studies in fermentation. The chemical dynamics of alcoholic fermentation by yeast: A. **Slator.** The results indicate that the reaction, measured by observing the change in pressure due to evolution of carbon dioxide, is the slow decomposition of a compound produced by the interaction of the enzyme and the sugar.—Some new platinocyanides: L. A. **Levy** and H. A. **Sisson.** Hydrazine and hydroxylamine platinocyanides are described.—An intramolecular change leading to the formation of naphthalene derivatives: E. F. J. **Atkinson** and J. F. **Thorpe.** Ethyl sodiocyanoacetate condenses with benzyl cyanide to form ethyl α-cyano-β-imino-γ-phenyl-*n*-butyrate. This, when treated with an equal weight of sulphuric acid, forms an intense green solution, which yields ethyl 1 : 3-diaminonaphthalene-2-carboxylate.—The relation of position isomerism to optical activity, V., The rotation of the menthyl esters of the isomeric dibromobenzoic acids: J. B. **Cohen** and I. H. **Zortman.** An account of certain physical constants, including the molecular rotations of the six isomeric menthyl dibromobenzoates.—Some derivatives of naphthoylbenzoic acid and of naphthacenequinone: J. O. **Orchardson** and C. **Weizmann.**—Ethyl β-naphthoylacetate: C. **Weizmann** and E. B. **Falkner.**—Contributions to the chemistry of the amidines. 2-Aminothiazoles and 2-imino-2 : 3-dihydrothiazoles. 2-Iminotetrathiazoles and 2-amino-4 : 5-dihydrothiazoles: G. **Young** and S. I. **Crookes.**—The action of water on diazo-salts: J. C. **Cain** and G. M. **Norman.** An extension of a method of investigation, already described, to diazo-salts from 2 : 4-dibromoaniline and dibromo-*p*-toluidine (*cp. Proc. Chem. Soc.*, 1905, xxi., 206).—Note on the atomic weight of nitrogen: A. **Scott.** A reply to Richards (*Proc. Amer. Phil. Soc.*, 1904, xliii., 116) showing *inter alia* that the recent work of Richards and Wells on the atomic weights of chlorine and bromine has cleared up the discrepancy between the numbers obtained by the author for the atomic weight of nitrogen (*cp. Journ. Chem. Soc.*, 1901, lxxix., 154).—The solubility of zinc hydroxide in alkalis: J. **Moir.** When zinc hydroxide dissolves in excess of caustic alkali, the phenomenon is essentially the production of an equilibrium between the alkali and the zincic acid, and no definite chemical compounds such as $ZnO,8KOH$ are formed.—The slow combustion of carbon disulphide: N. **Smith.** The reddish-brown deposit formed when carbon disulphide and oxygen are passed through a heated tube consists chiefly of an acidic compound $C_{16}H_6O_4S_9$. The silver and ammonium salts have been prepared.

PARIS.

Academy of Sciences, December 26, 1905.—M. Troost in the chair.—Researches on the insoluble potassium compounds contained in humic materials: M. **Berthelot.** Powdered wood charcoal, after careful extraction with dilute hydrochloric acid and water, was treated with dilute solutions of potassium acetate and calcium acetate, the constituents of the charcoal ash being determined before and after the treatment. The results are compared with those obtained previously in which the charcoal was washed with water only, and conclusions drawn as to the nature of the potassium salts existing in wood charcoal.—On a standard of light: J. **Violle.** A description of some attempts to establish a standard of light by utilising the constant temperature obtained by boiling silver and copper.—On a new petrographic type of certain leucotephrites from Somma: A. **Lacroix.**—New observations on the formation and the quantitative variations of the hydrocyanic principle of the black elder: L. **Guignard.** The amount of the glucoside falls off very slightly with the increase of age of the leaf. At the end of the vegetative period it does not pass into the stem, but remains in the leaf when it falls off, and hence cannot be regarded as a reserve substance.—The influence of some factors on experimental parthenogenesis: Yves **Delage.** Numerous chemical reagents can bring about experimental parthenogenesis, and the conditions may also be varied, but the

fundamental action or condition still remains to be determined. The variable results obtained with the same reagent under, apparently, the same experimental conditions are pointed out, showing the necessity of averaging a large number of experiments before drawing conclusions. The reagent which has given the best results is made up of sea-water, 3 c.c., solution of NaCl of $2\frac{1}{2}$ molecules per litre, 45 c.c., distilled water, 72 c.c., sulphite of soda, 5 drops.—On the identity of surra and mbori: A. **Laveran.** It has already been shown that morphologically the trypanosomes of surra and mbori were nearly identical, and also that animals which had been rendered immune to surra were practically immune to mbori. In the present paper it is shown that an animal which has acquired immunity for mbori is also immune for surra, and hence the conclusion is drawn that the trypanosomes in these two diseases belong to the same species. The trypanosome of mbori is a less virulent variety of *Trypan. evansi.* —Observations on the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the first quarter of 1905: J. **Guillaume.** The results are summarised in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—On isothermal surfaces and a class of envelopes of spheres: A. **Demoulin.**—On some generalisations of Picard's theorem: C. **Carathéodory.** —On the non-stationary movement of a fluid ellipsoid of revolution which does not change in figure during the movement: W. **Stekloff.**—On a transformation of certain linear partial differential equations of the second order: J. **Clairin.**—Reclamation of priority regarding an apparatus of M. Nodon for examining the solar protuberances at any time: Antoine **Sauve.**—On the propagation of light in a system in translation and on the aberration of the stars: G. **Sagnac.**—On the mechanism of the production and the nature of kathodic pulverisations: Ch. **Maurain.** The kathodic pulverisations appear to consist of moderately large particles, torn from the kathode by the shock of the α rays, and charged electrically, but with an e/m much smaller than for the projectiles constituting the kathode rays.—On the mobilities of the ions of saline vapours: G. **Moreau.**—On the respective spectra of the different phases of the electric spark: G. A. **Hemsalech.** Using the arrangement of apparatus described in an earlier note, the author finds that the electric discharge gives a line spectrum in non-ionised air and a band spectrum in ionised air. It is shown that a single oscillation is capable of producing and rendering luminous the metallic vapour.—The sulphates of samarium: Camille **Matignon.** The methods of obtaining the acid and basic sulphate from the neutral sulphate are given, together with the properties of these salts.—The action of acetylene on iodine pentoxide: Georges F. **Jaubert.** Acetylene is quantitatively oxidised to carbon dioxide by iodine pentoxide at 80° C. In the estimation of carbon monoxide in the air by the iodine pentoxide method, it is therefore necessary to ensure the absence of acetylene by appropriate reagents.—The action of glucose on selenious acid: MM. Œchsner **de Coninck** and **Chauvenet.** In the reduction of selenious acid by glucose, a red amorphous colloidal variety of selenium is produced, insoluble in carbon bisulphide. At 100° C. it is partially converted into black selenium.—The action of ammonia gas on the tribromide and triiodide of phosphorus: C. **Hugot.** A yellow amide of phosphorus is formed by this reaction at low temperatures; at higher temperatures it is decomposed, phosphorus imide being formed.—On the methods employed by the Arabs to get metallic lustre on enamels: L. **Franchet.**—On a new mode of preparation of barium: M. **Guntz.** The purest metal obtained in previous work contained 98·5 per cent. of barium. If this is converted into the hydride, and the latter heated *in vacuo* at 1200° C., the sublimed metal is crystallised and of 99·5 per cent. purity.—On some new derivatives of pentabasic phosphoric acid, $P(OH)_5$: P. **Lemoult.**—Syntheses of derivatives of 1:4:7 symmetrical heptanetriol: J. L. **Hamonet.**—Products of the hydrogenation of carvacrol: Léon **Brunel.** An account of the results obtained by the application of the Sabatier and Senderens method to carvacrol.—Some liquefying and hydrolysing actions of starch: P. **Petit.**—On the presence of trachytes and hypersthene andesites in the Carboniferous strata of Corsica: M. **Deprat.**—On *Raphia Ruffia*, a wax-producing palm: Henri **Jumelle.**—On an important variation of the tuber of *Solanum Maglia*: Édouard **Heckel.** Experimental work tending to confirm the view of de Candolle that this is the wild species from which the cultivated potato is derived.—On the use of manganese as a manure: Gabriel **Bertrand.** An account of some experiments, made on the agricultural scale, showing the beneficial effect of the addition of manganese sulphate as a manure.—The assimilation of carbon dioxide by the chrysalids of Lepidoptera: Mlle. Maria **von Linden.**—On the parallelism between phototropism and artificial parthenogenesis: Georges **Bohn.**—On the independence of metamorphosis and the nervous system in batrachians: P. **Wintrebert.**—On the inoculation of cancer: M. **Mayet.** The soluble products obtained from a cancerous tumour in man, free from solid matter by filtration through porcelain, and injected into a dog, gave rise to a cancerous growth. —The pathological nature of the Holmgren canals of nerve cells: R. **Legendre.** The author's views are in direct opposition to those of Holmgren concerning the function of the cavities in nerve cells, and he regards them as pathological in nature.—On the discovery of Amphibia in the Coal-measures of Commentry: Armand **Thevenin.** —Magnetic observations at the Observatory of Ebre on the occasion of the eclipse of the sun of August 30, 1905: P. **Cirera.**

January 2.—M. H. Poincaré in the chair.—On the estimation of carbon monoxide in air by iodic anhydride: Armand **Gautier.** With reference to the note by M. G. Jaubert in the last number of the *Comptes rendus*, the author points out that he published this fact in 1898, and has also shown how to correct for the error introduced into the determination by the presence of acetylene. Acetylene does not occur in the air of towns. —New observations on the Pycnogonides collected in the Antarctic regions in the course of the expedition directed by M. Jean Charcot: E. L. **Bouvier.**—On the deformation of quadrics: C. **Guichard.**—On the mutations of some fossil plants of the Coal-measures: M. **Grand'Eury.** A *résumé* of the results obtained by the author during the last ten years.—Observations of Giacobini's comet (1905*c*) made at the Observatory of Toulouse with the 38 cm. Brunner-Henry equatorial: F. **Rossard.** Observations made on December 18 and 22, 1905, showing the positions of the comparison stars and apparent positions of the comet.—Provisional elements of Giacobini's comet (1905, December 6): E. **Maubant.**—Observation of Giacobini's comet (1905*c*) made with the 16 cm. Brunner equatorial at the Observatory of Lyons: J. **Guillaume.** Observations made on December 12, 1905. The comet appeared as a diffuse luminosity of 30″ to 40″ diameter. —Photographic study of the annular nebula in Cygnus, N.G.C. 6894: Gabriel **Tikhoff.** The details shown by the photograph are in general agreement with those published by Keeler, from the Lick Observatory. Theorem on entire functions: M. **Auric.**—A contribution to the study of photographic screens: J. **Renaux.** Remarks on the use of colouring matters for photographic screens.—Researches on the terrestrial field, carried out during the total eclipse of August 30, 1905: Charles **Nordmann.**—On the determination of the rare gases in natural gaseous mixtures: Charles **Moureu.** A diagram of the scheme of apparatus used by the author is given, together with exact details of working. Oxygen and nitrogen are removed by hot lime and magnesium mixture, hydrogen and hydrocarbons by heated copper oxide, moisture and carbon dioxide by phosphoric anhydride and soda lime respectively. The last traces of nitrogen are removed by metallic calcium.—On the heat of fusion of ice: A. **Leduc** (see p. 254).—On the synthesis of the amido-acids derived from the albumens: L. **Hugounenq** and A. **Morel.**—The structure of plants developed in the light, without carbon dioxide, and in presence of organic materials: M. **Molliard.** The essential characters of plants cultivated under the above conditions are a structure resembling that of the subterranean organs and the formation of tissue with plurinucleated cells.—Symbiosis of orchids and several endophytic fungi: Noel **Bernard.**—On the copepods collected by the Charcot expedition and communicated by M. E. L. Bouvier: M. **Quidor.**—On a new micro-

sporidium, *Pleistophora macrospora*: Casimir **Cépède.**—On the intimate structure of the protoplasm in the Protozoa: Emmanuel **Fauré-Fremiet.**—A respiratory apparatus for the exploration of places filled with irrespirable gases: M. **Guglielminetti.** The apparatus consists of three parts, the bottle of compressed oxygen, the regenerator and cooler, and the respiratory mask. Illustrations are given showing a diagrammatic arrangement of the whole apparatus, and its position in actual use. Its weight is 13 kilograms.—Observations made on Mt. Blanc on the effect of altitude on the blood: H. **Guillemard** and R. **Moog.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 11.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Charing Cross Company's City of London Works: W. H. Patchell (*Conclusion of Discussion*).

LONDON MATHEMATICAL SOCIETY, at 5.30.—On the Diffraction of Sound by Large Cylinders: J. W. Nicholson.—On the Monogeneity of an Algebraic Function: Dr. H. F. Baker.—On the Expression of the so-called Biquaternions and Triquaternions with the aid of Quaternary Matrices: J. Brill.

FRIDAY, JANUARY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Annular Nebula in Lyra: E. E. Barnard.—(1) Star Reductions: (2) The Work of a Colonial Observatory: W. E. Cooke.—(1) Elements and Light Curve of RV Lyræ; (2) Elements and Light Curve of VW Cygni: A. Stanley Williams.—The Value of the Constant of Refraction: L. de Ball.—Observations of Comet *b* 1905 from Photographs taken with the 30-inch Reflector of the Thompson Equatorial: Royal Observatory, Greenwich.—On a New Method of Determining the Absolute Dimensions of an Algol Variable: A. W. Roberts.—Report on Observations of Jupiter, 1904–5, made at Trincomali, Ceylon: Major P. B. Molesworth.—Mean Areas and Heliographic Latitudes of Sun-spots in the year 1904, deduced from Photographs taken at Greenwich, at Dehra Dûn, at Kodaikánal Observatory (India), and in Mauritius: Royal Observatory, Greenwich.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lecture on the Theory of Machines: Prof. J. D. Cormack.

MALACOLOGICAL SOCIETY, at 8.—Note of the Dates of Publication of C. L. F. von Sandberger's "Die Land- und Susswasser-conchylien der Vorwelt," 1870–75: B. B. Woodward.—New Species of Siphonaria, Terebra, and Maugilia, and a Remarkable Form of *Cypraea cruenta*, from South Africa: G. B. Sowerby.—Remarks on some Forms of Chloritis with Description of a New Species: G. K. Gude.—Notes on the Anatomy of S. African Aplysiidæ with Descriptions of two New Species: R. H. Burne.—Notes on *Voluta kenyoniana*, *V. papillosa*. var. *costata*, *V. roadknighti*, Juv., *Cypraea tigris*, var. *lineata*, and *Conus waterhousae*, var. *mauritiana*: Mrs. Kenyon.—Description of a New Species of Crepidula from Victoria: Mrs. Kenyon.

MONDAY, JANUARY 15.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—British East African Plateau Land and its Economic Conditions: Major A. St. Hill Gibbons.

VICTORIA INSTITUTE, at 4.30.—Evolutionary Law in the Creation Story of Genesis: Rev. A. Irving.

TUESDAY, JANUARY 16.

ROYAL INSTITUTION, at 5.—Impressions of Travel in China and the Far East: Prof. E. H. Parker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: The Elimination of Storm-water from Sewerage Systems: D. E. Lloyd-Davies.—On the Elimination of Suspended Solids and Colloidal Matters from Sewage: Lieut.-Colonel A. S. Jones and Dr. W. O. Travis.

ZOOLOGICAL SOCIETY, at 8.30.—On Bones of the Lynx from Cales Dale, Derbyshire: W. Storrs Fox.—On Mammals from South Johore and Singapore collected by Mr. C. B. Kloss: J. Lewis Bonhote.—Contributions to the Anatomy of the Ophidia: F. E. Beddard, F.R.S.—On the Minute Structure of the Teeth of Creodonts, with Especial Reference to their Suggested Resemblance to Marsupials: Charles S. Tomes, F.R.S.

WEDNESDAY, JANUARY 17.

SOCIETY OF ARTS, at 8.—The Scientific Aspects of Voice Development: Dr. W. A. Aikin.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President's Annual Address: The Life and Work of Bernard Renault.

ROYAL METEOROLOGICAL SOCIETY, at 7.45.—Meteorology in Daily Life: Richard Bentley.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Factors which Determine the Production of Intraocular Fluid: E. E. Henderson and Prof. E. H. Starling, F.R.S.—A Critical Account of some Anomalous Conditions of the Cerebrum in the Human Fœtus: Dr. W. L. H. Duckworth.—A Case of Regeneration in Polychæte Worms: Arnold T. Watson.—On the Infection, Histology, and Development of the Uredo Stage in certain Uredineæ: I. B. P. Evans.—On the Synapsis in Amphibia: J. E. S. Moore and Miss Embleton.—On the Constancy of Form among the Synaptic Gemini (Heterotype Chromosomes) in certain Animals: J. E. S. Moore and G. Arnold.—The Growth of the Oocyte in Antedon: a Morphological Study in the Cell Metabolism: Gilbert C. Chubb.

CHEMICAL SOCIETY, at 8.30.—The Refractive Indices of Crystallising Solutions with Especial Reference to the Passage from the Meta-stable to the Labile Condition: H. A. Miers and F. Isaac.—The Determination of Available Plant Food in Soils by the Use of Weak Acid Solvents. Part II.: A. D. Hall and A. Amos.—The Action of Ammonia and Amines on Diazobenzene Picrate: O. Silberrad and G. Rotter.—The Preparation of *p*-Bistriazobenzene: O. Silberrad and B. J. Smart.—Gradual Decomposition of Ethyl Diazoacetate: O. Silberrad and C. S. Roy.—Studies on Nitrogen Iodide. Part III. The Action of Methyl and Benzyl Iodides: O. Silberrad and B. J. Smart.—Silicon Researches. Part X. Silicon Thiocyanate: J. E. Reynolds.—The Relations between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—Halogen Derivatives of Substituted Oxamides: F. D. Chattaway and W. H. Lewis.—The Effect of Constitution on the Rotatory Power of Optically Active Nitrogen Compounds. Part I.: Miss M. B. Thomas and H. O. Jones.—Menthyl Benzene Sulphonate and Menthyl-β-Naphthalene Sulphonate: T. S. Patterson and J. Frew.—An Apparatus for the Continuous Extraction of Liquids with Ether: R. S. Bowman.—Action of Bromine on Benzeneazo-*o*-Nitrophenol: J. T. Hewitt and N. Walker.—Some Reactions and New Compounds of Fluorine. Part I.: E. B. R. Prideaux.—The Relation between Absorption Spectra and Chemical Reactivity. Part II. The Quinones and α-Diketones: E. C. C. Baly and A. W. Stewart.—The Relation between Absorption Spectra and Chemical Reactivity. Part III. The Nitroanilines and the Nitrophenols: E. C. C. Baly, W. H. Edwards, and A. W. Stewart.—Contributions to the Chemistry of the Rare Earths. Part I.: M. Esposito.—A Synthesis of Aldehydes by Grignard's Reaction: G. W. Monier Williams.—The Condensation of Dimethyldihydroresorcin and of Chloroketodimethyltetrahydrobenzene with Primary Amines. Part I. Monamines, Ammonia, Aniline, and *p*-Toluidine: P. Haas.

SOCIETY OF ARTS, at 4.30.—The City of Calcutta: C. E. Buckland.—At 8.0.—High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Life-history of *Margaritifera Panasesae*: A. W. Allen. On some Endophytic Algæ: A. D. Cotton.—Jacobson's Organ of Sphenodon: Dr. R. Broom.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 9.—Some Applications of the Theory of Electric Discharge to Spectroscopy: Prof. J. J. Thomson, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Behaviour of Materials of Construction under Pure Shear: E. G. Izod (*Resumed Discussion*): Worm Contact: R. A. Bruce.

CONTENTS.

THURSDAY, JANUARY 18, 1906.

THE HIGHER TELEOLOGY.

The Interpretation of Nature. By C. Lloyd Morgan, LL.D., F.R.S. Pp. 164. (Bristol: J. W. Arrowsmith; London: Macmillan and Co. Ltd., 1905.) Price 2s. net.

PROF. LLOYD MORGAN stands as a daysman between the naturalistic and the teleological interpretations of Nature, and the result of his arbitration is that both are valid, though neither by itself is satisfying. Naturalism aims at an analysis of occurrences in terms of the simplest possible formulæ—mechanical by preference—at a genetic description of the stages by which any particular configuration—the solar system, the scenery of Scotland, the simplest organism, Man and his mind—has come about. "It finds its principle of unification in the universality and inter-connection of world-events; it works inwards from external nature to the life and mind of man which it interprets as expressions of natural law." It is a stern way of looking at things, knowing nothing of beginnings or ends, never asking "why?" and never really answering even the question "how?" It flourishes William of Occam's razor, searching as he who shaved Shagpat for the periodically sprouting "identical," "principle" or "entity" to lop it off. It speaks not willingly of "causes," but deals with "antecedent conditions." "It regards the state of the whole universe at any given moment as a configuration of very great complexity, involving accelerations of many different orders co-existing in natural relationship, and it believes that the cause or condition of this configuration is that of the preceding moment, while the configuration of the succeeding moment is its effect. This involves a splendid act of faith, for it assuredly outruns what can, in the present state of knowledge, be definitely proved."

While many thinkers have sought to stay the progress of the triumphant chariot of Naturalism by exhibiting notices "No road this way," the chariot-drivers have paid no heed, but have gone nonchalantly on through the policies of Life and Mind, of Morals and Society, only pausing, as courtesy demanded, to say that they were giving no explanations, merely genetic descriptions. What is particularly interesting in Prof. Lloyd Morgan's attitude is that he wishes them God-speed, and is entirely disinclined to call a halt at any particular difficulty in the way of naturalistic formulation. It is true, he says, that the antecedent conditions of the genesis of protoplasm, for instance, are unknown, but they may not remain unknown, and "those who would concentrate the mystery of existence on the pin-point of the genesis of protoplasm do violence alike to philosophy and to religion." Or again, in reference to the naturalistic doctrine of the ego, that what we call mind is, from the restricted point of view of scientific psychology, the name we apply to a sequence of mental configurations, the author writes:—"But—it can't be proved. Never mind that. Some day it may be proved. And in any case to believe more than can be reduced to actual demonstration is not only a characteristic of human nature, but often one of the prime conditions of progress." It is evident, then, that this arbiter fully appreciates the naturalistic universe of discourse, and has no timidity in wishing that its ideal of formulation may be realised. For in proportion to the realisation of the naturalistic aim, which is to formulate our routine of experience in terms of the simplest possible ideal constructions, in proportion to its disclosure of determinate evolution all along the line, in proportion to its elimination of "purpose," "causal agency," and "end" from its universe of discourse, it will become clear that this mode of interpretation, however necessary and valuable for scientific workmanship, is too partial and abstract to satisfy those who feel that the purpose of their life is the most intimate and fundamental reality of which they have any knowledge. In other words, it is the aim of Lloyd Morgan's eirenicon "to show that a belief in purpose as the causal reality of which nature is the expression is not inconsistent with a full and whole-hearted acceptance of the explanations of naturalism within their appropriate sphere."

This little book deals with big questions, and many who have pondered over them will be grateful to the author for the lucidity of his argument, which is an expression of his own clear vision, and is also perhaps partly due to the fact that the book took shape as the Lowell lectures for 1904. Many will be grateful, we believe, for more than the pleasure of reading a vivid and stimulating course of lectures, namely, for a liberation from the obsession of a mechanistic outlook. The author expounds the naturalistic scheme with great sympathy, while disclosing its implications and limitations, but he maintains convincingly that "a complete and satisfactory interpretation of nature is, so far as it is attainable by man, partly scientific and partly metaphysical." We look, as it were, for a greatest common measure as well as a lowest common denominator of the fractions of reality which make up our experience. We cannot remain satisfied with a description of the observed moves among the pieces on the chequered chess-board of experience; we cannot but ask "how there comes to be a game to be played, and when this is settled how, or by what unseen agency, castles and knights and pawns are moved, each with a distinctive path, across the board." But this is beyond science; it is the other side of the shield; and the problem is:—By what ideal construction, valid in reason and valid in life, can we supplement the partiality of the naturalistic outlook? In a way of his own the poet feels that the whole universe "trembles with song"; the artist in his outlook, certainly not the least sane, has as little use for mechanistic categories as the mechanist has for wood-nymphs; the religious mood sees the iron chains of determinate evolution transmuted into golden chains which bind all things about the feet of God. But what more universal outlook is there for plain men dwelling in tents?

The answer given in this eirenicon is simple in expression but far-reaching in its outcome. It is that

"purpose is that of which all determinate sequence is the phenomenal expression." "Naturalism proclaims that I am just a little bit of nature, differentiated from the rest, a minute cluster of phenomena in relation with the total remainder of phenomena, a tiny, if somewhat complex configuration under the influence of the major configuration of the universe." But "I cannot do away with the conviction that there is something within me which unifies and relates and orders the configurations, something which is the source of my conception of causal agency. It is what I understand by *purpose*." . . . "But why should I suppose that the causal agency which, as purpose, underlies my own private and peculiar configuration, is of a different order of being from that of which nature at large is a manifestation. Just in so far as I *am* one with nature, and therefore in physical relationship with other manifestations in terms of matter and energy, is the purpose of my being one with the purpose which underlies the manifestations of nature, and am I in spiritual relationship with a wider and richer purpose which is thus manifested."

We agree so heartily with this higher teleology that we have no criticism to offer. We doubt, however, whether it is necessary to deal so generously with the naturalistic interpretation in its mechanistic expression as the author has seen fit to do. It may be well methodologically to deal with it as an ideal, but we cannot help feeling that its realisation is very far from being within the sphere of practical politics. Our other difficulty is that we cannot think of the concept purpose except as related to personality, except as an attribute or aspect of a larger reality still, which thinkers of all ages have spoken of as "Spirit."

J. A. T.

TWO BOOKS ON THE SOIL.

Bodenkunde. By E. Ramann. Second edition. Pp. xii+431. (Berlin: Springer, 1905.)

Soils and Fertilisers. By Prof. H. Snyder. Second edition. Pp. x+294. (Easton, Pa.: The Chemical Publishing Co., 1905.) Price 1.50 dollars.

DR. RAMANN'S treatise on soils, which has grown out of an earlier book on forest soils published in 1895, is of very different type and design from such books on the same subject as have appeared in English. In the first place, a considerable portion of the book is occupied with a somewhat generalised and academic consideration of the soil, its origin, its relation to climate and vegetation, its types, &c., in all of which the point of view of the geographer, the geologist, or the botanist is more to the fore than that of the farmer. Soils and their constituents and properties are classified and described as though they were a set of museum specimens, with little or no reference to their behaviour in the field. Indeed, the author has rather a passion for classification, and the work contains too many generalisations and definitions of the following kind, which are accorded the dignity of large type.

"*Bodenkraft* is the sum of all the chemical and physical properties of the soil. *Fruchbarkeit* is the relation between *Bodenkraft* and the development of plants. *Ertragsvermögen* is the relation between *Fruchbarkeit* and climatic factors in their action upon plant colonies or single kinds of plants."

Such definitions sound well in lecture, and serve to fill the industrious listener's notebook, but they do not help him much in the study of the real thing.

Similarly, in those sections of the book dealing with the examination of soils, we get directions for the carrying out of this or that determination—chemical analysis, water capacity, specific heat, &c.—but of the interpretation of the results we hear nothing at all. We are not, in fact, instructed how to add up that sum which is to indicate the fertility of the soil. But in its own special line Dr. Ramann's book cannot fail to be useful to our workers at the scientific study of soils. It is particularly good in dealing with the part of the subject most neglected in Britain, the physical properties of soils, and the portion in which Dr. Ramann is perhaps specially interested—the study of forest soils—contains an excellent summary of work that is almost unknown here. Such matters as the growth of forest soils, the effect of the leafy covering on the chemical composition, the temperature and the water content of soils, are dealt with at length; as again in later chapters are the questions of zones and types of soil and their delimitation upon soil maps. As a book of reference to modern German research on the soil (French and English investigations are practically ignored) Dr. Ramann's treatise will be of considerable service to the specialist; for the agricultural student or the farmer it will not serve.

Prof. Snyder's little book has been constructed out of a series of notes supplied to the students of his classes at the University of Minnesota, expanded somewhat and made more complete by the addition of descriptions of laboratory experiments upon soils and fertilisers. Essentially, however, the book still consists of notes which will serve to remind the student of the matter dealt with in the lectures; they lack both the filling in and the elucidation that comes from the lecturer himself. Too many things are mentioned and left without any adequate explanation, as though the author were afraid to pass them by wholly without notice, yet knew at once that he could not afford the time or space necessary to develop them properly. The result is a book which fulfils its original purpose of lecture notes, but when taken by itself is dull and difficult to read, and, as we would contend, a mistake educationally. A text-book should not be a miniature encyclopædia, and though the teacher is well advised in making occasional excursions into higher work beyond the average reach of his students, it should be done by working out principles, and not by scrappy enumerations of more advanced investigations.

But instead of criticising a book for what it is not, it is fairer to try and appreciate what it does accomplish. Prof. Snyder is a well known member of the band of American experiment station workers who have done so much to advance the application of science to the everyday practical side of farming, and have succeeded in making the United States

farmer regard the investigator as his necessary helper in the conduct of his business.

In matters connected with the physics of the soil and its bearing upon the operations of cultivation the American workers have accumulated much novel information, and to this some of the chapters of Prof. Snyder's book form a good introduction. The requirements of the crop are treated from a sound general standpoint which never forgets that water and air, soil texture, and cultivation are perhaps the prime factors in plant production. In this country students are a little too apt to fancy that farming begins and ends with the application of artificial manures; we can recommend this book to them for the truer point of view, even though the conditions which regulate our use of manures are not quite the same as in America.

RECENT ASPECTS OF ELEMENTARY GEOMETRY.

The First Book of Geometry. By Grace Chisholm Young, Ph.D., and W. H. Young, M.A., Sc.D. Pp. xvi+222. (London: J. M. Dent and Co., 1905.) Price 1s. 6d. net.

Of late years a very remarkable change has been made in the theory of elementary geometry, the general effect of which has been to make it more abstract, and to reduce a great deal of it to the application of logic without any appeal to intuition. It has been realised that geometry must be based on the assumption of certain undefinable entities, of elementary relations between them, and a complete system of independent axioms. For the purposes of ordinary Euclidean geometry, it is probably the simplest way to assume the straight line as the one undefinable entity, and intersection as the elementary relation from which the notions of point and plane may be derived. What system of axioms we adopt will partly depend upon the nature of the geometry we study; for instance, the axioms which are necessary and sufficient for the purposes of projective geometry require supplementing when we discuss the theory of measurement.

It is the theory of measurement which presents the greatest difficulty at the present time. If we assume all the results of projective geometry, we may proceed as follows:—Taking any three points O, I, X on a line, we may associate them with the numbers (or indices) 0, 1, ∞ (where ∞ is the vague infinity of ordinary arithmetical algebra). We can then give a purely projective rule for finding a point on the line to be associated with any given rational number p/q; we thus get on the line a set of points corresponding to the whole field of rational numbers, and, moreover, the arrangement of the points corresponds to the arrangement of the numbers according to their magnitude; that is, if $m>n>p$, the point N lies on that segment MP which does not contain X. If we like, we can define the distance AB as being measured by $b-a$, where a, b are the indices of A, B. This satisfies the relation $AB+BC=AC$, but equal segments as thus defined are not intuitionally equal, except when X is "the" point at infinity on the line; and even then we cannot prove, but must assume the intuitional equality. Moreover, there are points on the line which do not have rational indices, unless, in spite of common sense, we assume that the points on the line form a discrete aggregate. Now in arithmetic we have a perfect continuous aggregate, where each irrational element separates all the rational ones into two complementary parts, respectively greater or less than itself. If we *assume* that all the points in the line which have not rational indices behave in a similar way, we have a complete correspondence between the succession of points on a line and the elements of the arithmetical continuum. So far as appears at present, this is a pure assumption; but if it is not made, anything like the ordinary theory of measurement seems to be impossible, for two distinct points ought to have a measurable distance, and the measure must be a number; if the two distinct points cannot be associated with two distinct numbers, how is their distance to be defined as a measurable quantity? Other difficulties arise in connection with transfinite numbers and their representation by point aggregates; but these are comparatively unimportant, it it is remembered that the assumption of the correspondence of points on a line with the arithmetical continuum involves a similar correspondence between the arithmetical continuum and the points on any finite segment.

It is very interesting to see how this recent theory has reacted on the question of teaching elementary geometry. Instead of tending to make it more abstract and more logical, it has done exactly the reverse; and the reason for this is not difficult to find. The notions of geometry, so far as it is distinct from logic, are derived from concepts, and these, again, from experience. There must be an intuitional basis for geometry; and although, from a logical point of view, it is desirable, *for any given species of geometry*, to reduce its necessary assumptions to a minimum, progress in geometrical invention is to be expected from those who cultivate their powers of observation as well as their logical faculties. One result of recent research has been to explode, once for all, the pretence that the "Elements" of Euclid present geometry in its most logical form; on the other hand, to try to teach beginners the subject in what would now be considered the most rigorous way would be certain to end in failure.

The book which has been written by Dr. and Mrs. Young illustrates very well what has just been said. Its main object is to awaken the pupil's mind to the ideas by which we classify the properties of space; this is done by directions in paper-folding, in dissection of areas, in the construction of solid models, and the like. At the same time, various theorems are stated and proved, so that the beginner may learn the difference between experimental and deductive geometry. As in the case of other text-books with a similar aim, the teacher will have to be careful to see that his pupil distinguishes proofs from verifications; *e.g.*, on p. 173 we have a proof that the angles of a triangle make up two right angles, while on p. 121 we have a verification in a special case.

There is no doubt that the kind of first course laid out in this book is the right one from a psychological point of view. A quite young pupil, actually carrying out its directions with the help of a sympathetic teacher, will obtain clear conceptions of geometrical facts in a way that is really interesting and fruitful. The apparatus required is of the simplest possible kind—paper, pins, a pencil, and a pair of scissors are all that are absolutely necessary, though a compass and a scale might be provided with advantage, except at the beginning of the course. The attention given to solid figures is a feature which deserves commendation; and above all there does not seem to be anything said that is likely to lead to misapprehensions, which have to be painfully corrected afterwards.

There are a few points of detail which might be attended to in another edition. The letters in the diagrams are too small; the figure on p. 151 does not correspond to the text; on p. 35, "This gives us another axiom" is quite illogical; and there are some technical terms which might have been spared. It must be remembered, too, that this is not a book for a beginner to *learn* in the old-fashioned way; it is intended to make him experiment and think, and the guidance of the teacher is essential. Assuming this, the book ought to be very useful, and lead to good results, even in the case of pupils who have little faculty for demonstrative geometry.

G. B. M.

LEGIBILITY AND VISUAL ACUITY.

Physiologie de la Lecture et de l'Écriture. By Emile Javal. Pp. xv+296. (Paris: Félix Alcan, 1905.) Price 6 francs.

THE title of this book, which is written by a distinguished ophthalmologist, is somewhat misleading. One would naturally expect such a work to deal with the neuro-muscular mechanism, central and peripheral, of reading and writing. In reality, it treats almost exclusively of the legibility of printed and written matter, and the physiological processes are investigated only in so far as they throw light upon this aspect of the subject, and give indications for increased facility and rapidity in reading.

In the first part of the book a brief historical account of epigraphy, writing, typography, stenography, musical notation, and writing in relief for the blind is given. Typography is illustrated by examples from Garamond (1540), adopted by Plantin, of Antwerp, and the two Elzeviers, of Leyden and Amsterdam respectively, from very elegant designs by Jaugeon (1704), and from the Imprimerie Impériale (Didot, 1811) and the Imprimerie Nationale (Marcellin Legrand, 1847). Theoretical considerations of visual acuity, treated in the second part, show that the visibility of a letter increases indefinitely with the illumination, whereas its legibility depends upon the neuro-epithelial mosaic of the retina, and is therefore independent of illumination above a certain minimum. Investigation of the mechanism of reading a line of print has shown that the eyes move in a series of jerks, in each of which a group of about ten letters is appreciated, the grouping being independent of the distance of the book from the eyes so long as this is consistent with legibility. Bar reading gives some indication of the relative part played by the two eyes when binocular vision is present. The difference of accommodation in different parts of a line when the book is held close to the eyes, as in myopia, is very appreciable, and must be taken into account in treatment; thus in a myope of 15 dioptres a line of 10 centimetres involves a difference of accommodation of about 7 dioptres. The characteristic features of letters are for the most part in the upper portion, so that attention is specially directed here; consequently it is easy to read with the lower halves of the letters covered, whilst the reverse occasions considerable difficulty. These considerations indicate some improvements in typography. They have been carried out in some designs prepared for the author by M. Ch. Dreyfuss. It will be admitted that the result is successful as regards legibility and rapidity of reading, though at no small cost to the artistic sense. M. Javal points out that nearly all the improvements are to be seen in the well known enamelled-iron advertisement of Willing; indeed, English printing as a whole compares favourably in his estimation with that of other countries.

The terrible misfortune of blindness overtook the author a few years ago, so that it is not surprising that he has given much attention to Braille type. Even those born blind rarely attain to a rate of 100 words a minute in reading, or 10 in writing. It is surprising to find that the tactile acuity of the blind is actually less than that of normal people; the reading finger tires rapidly, and though the acuity of other fingers is greater, they are comparatively useless for reading. The author gives valuable suggestions for improving and simplifying Braille type, as well as general instructions as to the hygiene of vision and of writing.

J. HERBERT PARSONS.

OUR BOOK SHELF.

Exercises in Quantitative Chemistry. By Harmon Northrop Morse. Pp. xx+356. (Boston and London: Ginn and Co., 1905.) Price 8s. 6d.

THE time when the sole desideratum in the training of the chemical student was the acquirement of greater or less proficiency in the processes of analytical chemistry has, happily, gone by. Courses of experimental work arranged with the view of familiarising him with the most important general reactions, the preparation of typical organic compounds, and the methods peculiar to physical chemistry are now recognised as the essentials of chemical training. The work under review has been written from this standpoint, and makes no attempt to present a course of work for the training of expert analysts.

Although much diversity of opinion must necessarily attach to the problem of the choice of an ideal course of exercises, the unbiased critic can have but little fault to find with the author's selection. At first sight the heterogeneous character of the sixty-four exercises creates an impression of a lack of systematic arrangement, but this is more apparent than real. The first eight chapters deal with the balance, the

barometer and thermometer, the calibration of apparatus for the measurement of liquids and gases, the preparation of standard solutions, the determination of specific gravity and molecular weights, and with the purification of substances. Analytical exercises involving gravimetric and volumetric measurements and the manipulation of gases are contained in the succeeding twelve chapters, the selection being such that the student acquires familiarity with a large number of different kinds of operations. Chapters dealing with the electrolytic determination of metals, the analysis of butter, and electrical heating appliances for laboratory use complete the work.

Much care has evidently been devoted to the text. The remarks on p. 167 in reference to Victor Meyer's vapour-density method are, however, quite unintelligible, and in the methods of butter analysis described no mention is made of the standardised apparatus and method of working which has been adopted in this country for the determination of the volatile acids. These, however, are blemishes of small import, and the book represents an addition to laboratory literature to which attention may be directed with confidence. H. M. D.

Handbook of Physiology for Students and Practitioners of Medicine. By Dr. Austin Flint. Pp. xxvi+877 and xvi plates. (London: Macmillan and Co., Ltd., 1905.) Price 21s. net.

THERE are reasons for congratulating the author of this book upon its appearance, and not the least of them is the cheery optimism everywhere displayed. The growth that has taken place in the subject in the course of the last half-century is no more remarkable than the courage with which this writer, at the end of that time, turns round to attempt its description. To old friends of his handbook this gallant effort must afford great pleasure. It is doubtful, however, whether, outside this circle, much influence can be anticipated for this volume, since it has many competitors appealing more directly to the market of the present time.

"It is the outcome of a desire to connect pure physiology with the physiology specially useful to physicians." Let it be said that there is but one physiology. The physiology, which is of use to medicine, is not an applied science with a wealth of knowledge accumulated in its special interest; it is the essence of the pure science of physiology. There are also anatomy and histology. It is useless to claim credit from an attempt to provide a judicious blend of these separated subjects, since they are now more conveniently, and usually, studied separately. In this case, also, the standard of the extraneous matter is such as in no way to raise the standard of the general contents of the book.

As to the treatment of the more legitimately included contents, much can be said briefly.

The additions which have been made to knowledge in the last twenty years have made their bow to the author of this book, and have had the honour of an introduction. The names on their visiting cards have been forgotten; their inventions have been expressed at such hurried interviews as frequently to have escaped comprehension. The fact that they have called in such numbers has, however, made an impression, of which this new edition forms the record. The additions of recent years are, however, of such importance that nothing short of a complete—even if concise—consideration of their nature will suffice. The kindly sketched shadows, which here vaguely occupy the space that ascertained facts should definitely fill, render it impossible to recommend this book for general reading. J. S. MACDONALD.

Penrose's Pictorial Annual. Vol. xi. The Process Year Book for 1905–6. Edited by William Gamble. Pp. xvi+168. (London: A. W. Penrose and Co., Ltd., 1905.)

LAST year, in bringing to the notice of our readers this annual illustrated review of the graphic arts, we suggested that the standard of the volume in every respect was so high that it would be exceedingly difficult to eclipse it in the future. We were, however, wrong in our surmise, for the present volume surpasses those that have preceded it and illustrates the high state of efficiency of processes in use at the present time.

In the production of such a volume the task of the editor was no light one, but with his large acquaintance with all process methods he has given us an excellent survey of the latest achievements in process work. As in previous issues, we have a number of most interesting articles on various methods of procedure and allied subjects, and mingled with them is a host of first-class illustrations indicating the type and quality of work that can be accomplished by the various processes now available. To mention a few of the host of illustrations, attention may be directed to the frontispiece, a specimen of power-press printed copper etching by Bruckmann, of Munich, examples of work with the metzograph screen, the new four-colour process of Mr. C. G. Zander, and the spray-relief process of the aërograph which illuminates the front of the cover of the volume. The reader must, however, refer to the book itself if he wishes to revel in high-class illustrations, for no object would be gained in referring any more here to the numerous pictures.

In concluding, one cannot but congratulate all those concerned in the production of this really beautiful volume. The book should not only be in the hands of all process workers, but in the possession of photographers and others interested in book illustration.

Philips' Large Planisphere. Designed by H. Gewecke. (London: G. Philip and Son, Ltd.) Price 6s.

MOST students of the aspects of the heavens are familiar with the small circular planisphere having a revolving disc which can be adjusted to show the stars visible at any time of the year. The new planisphere now available is constructed upon the same plan as the earlier one, but its diameter is about twenty inches, and some changes have been made with the view of adding to its usefulness. The horizon can be taken off so that the whole of the chart can be seen if desired. A graduated strip is arranged across the chart, and by means of it the position of an object can be found when the right ascension and declination are known. The scale of right ascension on the outer edge of the circular chart is in degrees, but it would have been more conveniently expressed in hours and minutes in the usual way

The chart shows all the stars visible to the naked eye from the north celestial pole to 33° south of the celestial equator. The distortion is very great in some parts, and it is difficult to identify a few of the groups on this account and because the spots representing bright stars are so large. Fourth magnitude stars are represented by rings, and the effect is very unsatisfactory. A chart of this kind should aim at conveying a more or less faithful impression of the appearance of the stellar sky, but these white rings on a blue ground spoil the picture and ought not to have been introduced. Though the chart is said to have been "designed both for beginners and advanced students of astronomy," we are afraid that beginners would find it very confusing, and that working observers of the heavens would derive little real assistance from it.

Lehrbuch der Meteorologie. Second edition. By Prof. Julius Hann. Pp. 642. (Leipzig: Herm. Tauchnitz, 1905.) Price 24 marks.

In the year 1901 the author of this volume published the first edition, and on its appearance it was universally announced as the "classic" of meteorological literature. The work itself was a veritable mine of information, and the host of reference to original sources made it an absolute necessity for anyone dealing with this science to have it in his possession.

We have now before us a second edition. In this the author has made considerable alteration. In the first place, the size of the volume, as regards amount of matter it contains, has been very much reduced, a host of original references have been dispensed with, and the subject is dealt with in a more brief form. So rapid has been the progress of meteorological science, and so many have been the changes in ideas on numerous fundamental issues, that in many places this matter has had to be completely overhauled. Thus, to take one instance, namely, the investigation of the upper air by means of kites, balloons, and *ballons-sondes*, new light has been thrown on the movements of atmospheric currents, and innumerable data collected relating to temperature, pressure, and other elements in the higher strata.

The above is one of many cases where reconstruction has been rigorously carried out. Further, the insertion of all this, the latest, material has necessitated a great number of new references, so that the present volume with regard to these may be considered as a supplement to the first.

Several new and useful tables have been inserted in an appendix, one of these being a table of mean monthly and annual temperatures of 143 places in different parts of the world.

In the text are eighty-nine figures, nine autotype plates, and fourteen charts. The get-up of the book is of the same high standard of order as that of the first edition, the paper and printing being all that could be desired.

The volume should be in the hands of everyone who is in any way interested in meteorology, and is another very valuable addition to our meteorological literature by the master of the subject.

The Uses of British Plants. By Rev. Prof. G. Henslow. Pp. vi+184. (London: Lovell Reeve and Co., Ltd., 1905.) Price 4s. 6d. net.

About forty years ago a book was published on the "Useful Plants of Great Britain," written by C. P. Johnson and illustrated by J. E. Sowerby. Judging from the few copies one meets with, there has not been in the past much demand for information of this nature, but there is some indication of increased interest being taken in economic botany. The arrangement adopted by Prof. Henslow, in which he follows the nomenclature and order laid down in Bentham's "British Flora," accompanied, too, by the same set of illustrations, makes this practically a companion volume. Owing to the cost of production or the discovery of better substitutes, several plants once grown in the British Isles for their products have gone out of cultivation; the dyes produced by Rhamnus, Genista, and Rubia have been superseded by aniline dyes, and very few woad mills remain; one of those still existing was described in NATURE, November 12, 1896; nettle-cloth is not likely to be revived unless the term is applied to the material produced from rhea or the Nilgherry nettle, two exotic Urticaceæ. Such productions, and the cultivation of certain plants formerly reputed to be efficacious, are mainly interesting on account of their historical association, and with these the author deals sufficiently fully; also he has given a good deal of space to the derivations of the Latin names. On the other hand, he might have enlarged with advantage in the case of those plants which are still cultivated or which are closely allied to plants of economic value. The book is restricted to flowering plants.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cheirality of Form of Crystals of Epsom Salt.

In studying the optical behaviour of the optically active biaxial crystals of zinc sulphate ($ZnSO_4 7H_2O$) and Epsom salt ($MgSO_4 7H_2O$), I found that the rotation (which, the crystal being trimetric, is the same for each optic axis) was to the left in all the thirteen crystals that I prepared. I then turned my attention to the crystalline form, which affords a more rapid means of determination of the cheirality, and is, moreover, applicable to small crystals. In the case of Epsom salt, twenty-two crystals were examined; sixteen of them were found to be positive, six doubtful, while not one was found to be negative. The crystal accepted as positive is that of which a diagram is given in Watt's "Dictionary of Chemistry" (vol. ii., p. 150, diag. 282, 1883). In examining the form, the smallest of the faces $+P/2$ and $-P/2$ was looked for, and then considered as belonging to the set of small faces, even if, as occasionally happened, others of the same set were large. The cheirality of form of zinc sulphate crystals is not marked enough to permit of any certainty of identification. The reason for this constant selection by the substance of a particular one of the two possible forms is perhaps that the crystallisation may have been occasioned by particles of organic dust that are themselves cheiral.

H. C. POCKLINGTON.

Deposits on Telephone Wires.

At East London, in the Cape Colony, one of the inhabitants recently complained that two telephone wires passing over his roof, an iron one, were seriously injuring it, and asked that they might be removed at once, and the building re-roofed at the cost of the Government. In support of his statements he referred to some lines of a whitish colour on the roof immediately under the wires. Many theories were advanced, one being that the moist sea air laden with salt had condensed on the wires, and that when the moisture had evaporated the salt had been shaken loose by the vibration and fallen on the roof, forming in time the lines referred to. The officials on the spot stated that they could taste the salt; but on some of the deposit being removed from the roof the iron was found to be quite intact. On the powder being analysed not a trace of salt or of any chloride, soluble or insoluble, could be found, and the result of the analysis showed the deposit to be nothing but silica, with very faint traces of iron and lime. The sand, a fine powder, must have been blown on to the wires when they were damp, and on evaporation of the moisture taking place have fallen on the roof owing to the vibration of the wires.

A SUBSCRIBER.

Sounding Stones.

Apropos of Mr. Tingle's letter of last week, it may be of interest to note that fairly good specimens of "sounding stones" occur at Corick, on the borders of the barony of Erris, co. Mayo. The bridge at this village is known as the "musical bridge," from the fact that stones which form the coping of the parapet give out a musical note when struck with a piece of stone or metal.

T. DILLON.

Ballina, co. Mayo, January 8.

MORE ABOUT JAPAN.

THE interest that has been awakened in Japan through her wonderful exploits in the war against Russia makes a book on her systems of fighting—both ancient and modern—particularly welcome when military experts are still marvelling at the perfection of her organisation in war time, bringing as it has done the success which follows as the natural result of attention to the smallest details.

In "The Fighting Man of Japan"[1] we have a very interesting little book by Mr. F. J. Norman, who is eminently fitted to discourse on the "Exercises and Training of the Samurai," having passed many years in Japan as instructor to some of the military and civilian colleges. As the author claims the indulgence of his readers in his preface, it is perhaps hardly fair to notice the grammatical errors that occur here and there, and after all they do not alter the interest of the book; but it would have been advisable to omit the blatant advertisements of a certain jujitsu school both at the beginning and end of the book, for the especial benefit of which the author confesses to have written his work.

The book is divided into four chapters, each of which deals with a separate subject. The first gives a rapid sketch of Japanese military history dating from 1543, which is as far back as our European knowledge of it extends, and incidentally giving a description of the spirit which animated the "Samurai" of old—and a very different one, it would appear from Mr. Norman's account, from that which guided our knights and crusaders; but East is East and West is West, and however much the Orientals assimilate our ideas of civilisation and education, the spirit will remain unaltered; their ideals and ours will for ever be as far distant as the poles. One example of this is enough:—"The bushi (or warrior) . . . held to the maxim that 'all is fair in love and war,' and scrupled not to resort to devices of the most dishonourable kind in order to gain a desired object"; and in the case of a hand-to-hand fight, were his opponent to fall or lose his sword this was regarded as the best possible occasion for hacking at him while he was down and unable to defend himself.

Mr. Norman considers the Dutch to have been the first to attempt to train a Japanese naval force, although he allows that the Portuguese and Spanish friars of the sixteenth century must be credited as the first instructors of the "Far Easterners" in the art of shipbuilding and the science of navigation. It is a remarkable fact not generally known that in the fifteenth and sixteenth centuries many modes of self-defence were practised by the Dutch that were almost identical with those used by the Japanese in the art of jujitsu. The question is, Did the Dutch take their ideas to Japan, or were they taught by the Japanese? A very interesting book illustrating many modes of self-defence that are the same as those used to-day by the Japanese was written early in the sixteenth century by one Nicolas Petter.

Speaking of the Portuguese and Spanish friars, the name of St. Francis Xavier stands out above all others on account of his wide personal influence among the Japanese, and this clever Jesuit made more converts to the Roman faith than have ever been made since by the missionaries of any other creed. That he loved the Japanese is proved by his writing to France early in the sixteenth century:—"These people (meaning the Japanese) are the delight of my soul." Unfortunately, his good influence was entirely destroyed by the arrival of European traders who exploited the unsuspecting Orientals in such an unprincipled way that they rose *en masse* and massacred almost every one of the foreigners, and after this regarded them with such distrust and detestation that it was many years before they could regain any foothold in the country.

An interesting chapter is that on the education of the naval and military officers, showing what a very fine sieve has to be passed through before the aspirants are thought capable and worthy of defending their country either as sailors or soldiers. The system of the fine sieve is of course applied to the officers only in each service; the rank and file receive a sound practical training, but "little or no attention is paid by the officers to the teaching of parade and show movements to their men. . . . Women not occupying the position in Japanese Society they do in the West, little or no pains are taken by the military authorities of the Mikado to cater for their amusement, and the result is one never sees any 'Agricultural Hall tomfoolery' in Japan."

FIG. 1.—Corps à Corps à la Japonaise. From "The Fighting Man of Japan."

The chapter on "Kenjutsu" deals with the affection the Japanese have always felt for the sword, and the great cleverness they exhibit when using it in a hand-to-hand fight. This cleverness would appear to be the result of much practice in "kenjutsu," for which a "shinai," or practice sword, is used, made from four strips of bamboo bound together at the

[1] "The Fighting Man of Japan." By F. J. Norman. (The Training and Exercises of the Samurai.) Pp. xii+79. (London: Archibald Constable and Co., Ltd., 1905.) Price 2s. 6d.

handle with a strong leather covering. One illustration here reproduced represents a *corps à corps à la Japonaise*, and, judging from the photograph, it is allowable to combine a trip with a hit, as one fencer is trying to knock his opponent over with a hit at the neck, at the same time taking his leg from under him with a sort of jujitsu trip.

The last chapter describes the sumō or wrestling of the Japanese—to many a most repulsive spectacle on account of the enormously fat bodies of the particular class of men who follow this profession; but a fight between two expert sumōtori is for the Japanese an event of almost national importance, and they flock in thousands to the huge amphitheatre in the centre of which the tussle takes place. The second illustration shows two combatants in a crouching position waiting for a chance to spring at each other.

The last few pages of the book are devoted to jujitsu, but as nothing new is said on this subject and the photographs are very poor there is no need to enter into detailed description. For the rest, a very pleasant hour may be spent over the perusal of this interesting little book.

E. W.

FIG. 2.—Tachi-ai, or watching for an opening. From "The Fighting Man of Japan."

THE MOTION OF THE MOON.[1]

PER ARDUA AD ASTRA should be the motto for a cultivator of the lunar theory. There is no austerer road to prove oneself a man of mettle. *Incredibile studium atque indefessus labor* was Euler's summary upon it, and improvement of method since Euler's time has diminished neither *studium* nor *labor*. The work now brought to completion has occupied Prof. Brown (and a computer) since 1895, almost to the exclusion of other researches, and for some years before that he was busied with developing its methods. Moreover, the present stage is only a level whence he can take breath to proceed.

It is a fact to remember in mathematical astronomy that problems mathematically identical are often astronomically opposite as the poles. The theory of the moon from a geometer's point of view is simply the theory of one of the planets. It is the special values of the constants alone which distinguishes the case. The astronomer seeks a correct ephemeris, but a mathematical instinct seeks to solve the question as a case of the problem of three bodies, and Delaunay's two enormous volumes will show what labours may be undertaken to obtain full literal development of the moon's coordinates which shall be approximate enough to meet the needs of the observer. Unfortunately the expressions when obtained are in many cases so imperfectly convergent that they give neither a solution of the three-bodies-problem nor do they surpass the observations in precision, as calculation should. It seems that unless some wholly new device is found we must be content to separate the problem into two parts, leaving literal developments for special mathematical researches throwing light upon the problem of three bodies, such as G. W. Hill's investigations of periodic moons of different mean motions, and making the developments essentially numerical when they are designed to form the basis for tables, although by so doing the former part loses all observational interest and the latter nearly all that is mathematical. Prof. Brown's theory is neither wholly numerical like that of Hansen nor wholly literal like that of Delaunay. The mean motion alone is treated as numerical, the other constants as eccentricities and inclination appearing in literal form. This was a plan Adams always urged, and from time to time he made considerable studies to give effect to it. When there otherwise remain four parameters according to powers of which each coefficient must converge, it is clearly an immense gain to omit a fifth when that fifth is answerable for all the worst cases of slow convergence; and while the mean motion may be considered known, it is hardly the case with the other constants, the lunar eccentricity, for example, and the ratio of the mean distances of the sun and moon being uncertain within the limits over which debate ranges, so that it is essential that the calculator should not be tied to a single set of elements at the outset.

Besides this idea Prof. Brown's research rests upon two clear and solid supports. First is the use of rectangular moving axes of reference, which he points out—and otherwise it seems to have passed from memory—was developed by Euler. But perhaps as much as anything his success is due to the brilliant transformation of the equations of motion given by G. W. Hill. It detracts not the least from Prof. Brown's achievement that his main ideas and methods are derived from earlier masters. The tools were ready to hand for one who had the learning and judgment to use them. Anyone who has faced a similar task knows that there remain abundant calls for resource and invention, as well as for comprehensive patience, in fitting given plans together and working them out abreast in every remote ramification of a subject, without fidgeting about "originality."

The work is not yet at a stage to put to proof by calculation of an ephemeris, which indeed would need the calculation of lunar places for a great many years backwards and forwards to prove that it is superior to Hansen, or to Hansen *plus* Newcomb. But even now it is almost certain that it will be so. First its methods are more intelligible and above

[1] "Theory of the Motion of the Moon." By Ernest W. Brown, F.R.S. In the Memoirs of the Royal Astronomical Society, vols. liii., liv., lvii.

board than those of Hansen, and so there is a better chance of correcting the errors, which no mortal can altogether escape. Next the constants are not stereotyped, and if it is necessary to change them the effect can be made visible; and for a searching piece of evidence, Prof. Brown has shown already that his calculations remove the last shred of disagreement between the calculated and observed motions of the moon's apse. Finally, in a recent analysis of the Greenwich observations back to 1750, Mr. P. H. Cowell has given a most striking verification of all Prof. Brown's coefficients.

When Prof. Brown constructs his tables there is an error Hansen fell into which he may be trusted to avoid. In order to improve the agreement with observation, Hansen introduced a certain empirical element. An empirical correction is better than nothing, but it cannot be too clearly recognised that until it is furnished with a theoretical basis it is no more than a mathematical *memoria technica.* Certainly its place is not in a set of tables, the sole function of which is to expose correctly and fully the consequences of a clear theory and definite elements, with the view of testing the one and amending the others.

R. A. S.

THE CONTROL OF THE GAS SUPPLY OF THE METROPOLIS.

THE notification of the metropolitan gas referees just issued differs in several respects from that for the preceding year, a change necessitated by the provisions of the London Gas Act, 1905. For some years past the London gas companies have been asking for the revision of their Acts, with reference more especially to the system of testing to which their gas is subjected. In the early days of gas supply, when there was free competition and the consumer had the choice of more than one company, no testing was regarded as necessary, but when, owing to the amalgamation and consolidation of the gas companies, the supply became a monopoly, a system of testing the purity and illuminating power of the gas was instituted. The whole of the arrangements for testing London gas, with the exception of one or two points specially laid down in some of the Acts, are left to the discretion of the gas referees, originally appointed under the City of London Gas Act, 1868. It was alleged by the companies that the requirements of the referees were too stringent and out of touch with the modern developments of gas manufacture. In January, 1904, a departmental committee of the Board of Trade was appointed to inquire and report as to the whole system of gas-testing in the metropolis. At the inquiry the committee heard evidence from the gas referees, and from representatives of the London County Council, the Corporation of London, and each of the three gas companies concerned. It is noteworthy that no actual consumer was heard, although on one of the most important points dealt with by the committee, the question of sulphur impurity, the committee in its report says, "It does not appear that any complaints are made by the inhabitants of other districts on the ground that the gas thus unpurified causes injury to health or is more destructive to articles such as leather, &c., than it is supposed to be in London."

The report of the committee was almost wholly favourable to the companies. The mode of testing for sulphuretted hydrogen is to be relaxed, a test lasting three minutes being substituted for one spread over 15 hours, and all sulphur compounds other than sulphuretted hydrogen may be, and henceforth will be, left in the gas. The evidence of the companies as to the amount of sulphur impurity under the new conditions was to the effect that an average of 35 grains per 100 c.ft. or under might be expected, with the possibility of an occasional rise to 40, the maximum under the Acts just repealed being 17 grains in summer and 22 grains in winter. The figures for the amount of sulphur present in the gas supplied by the South Metropolitan Company during December last throw an instructive light on the value of this evidence, the weekly average increasing from 40·8 to 44·6 grains per 100 c.ft. with a single maximum of 61·3. On one occasion the Commercial Gas Company surpassed even this figure with a maximum of 70·2. It is clear, therefore, that the gas now to be supplied to London may contain about double the amount of sulphur contemplated by the departmental committee, and this is of interest in view of the fact that a Bill is now before Parliament promulgated by various provincial gas companies asking to be placed in the same position as the London companies as regards the removal of sulphur restrictions.

In one point the report of the departmental committee was favourable to the consumer. It recommended that the standard burner for testing the illuminating power of all qualities of gas should be the burner at present in use, the Sugg's London Argand No. 1, the gas to be burnt at the rate of five feet per hour. The gas referees in their present notification disregard this recommendation, and prescribe a burner devised by the engineer to the South Metropolitan Gas Company. The practical effect of this will be to increase the nominal illuminating power of the gas supplied by those companies having a 14-candle standard. It will be seen, therefore, that the new conditions are wholly favourable to the companies.

There remains one new point in the gas referees' notification, the prescription of a method of determining the calorific power of gas. The calorimeter, which has been devised by Mr. C. V. Boys, appears to be a distinct advance over its predecessors of the same type, and when it is installed in the testing stations systematic measurements of the calorific power of London gas will, for the first time, be on record, and will be available for the next battle on the gas question, calorific power *v.* illuminating power.

PROF. C. J. JOLY, F.R.S.

THE lamentable death of Prof. C. J. Joly at the early age of forty-one closes a career which was likely to influence favourably the mathematical side of astronomy. But his tenancy of the post of Royal Astronomer of Ireland and Andrews Professor in the University of Dublin was, alas! too short for him to make his individuality felt in the science with which he was connected by his occupancy of the chair, that has of late been held by Sir Robert Ball and Dr. Arthur Rambaut. The traditions of the office, and it may be the interrupted work of these astronomers, would naturally compel him for a time to follow certain definite lines which the previous occupants of the chair had approved. But his work in the department of pure and applied mathematics was of a high order and affords abundant evidence of originality and capacity.

From the time that Prof. Joly entered Trinity College, Dublin, his academic career was marked by his devotion to natural science, and mathematical scholarships and studentships were the natural preliminaries that led to a later fellowship. In this position he distinguished himself as a successful teacher of advanced science, but in 1897, when Dr. Arthur Rambaut was appointed to the office of Radcliffe observer, Dr. Joly

succeeded to the chair of astronomy, and his lectures and teaching were necessarily more limited.

Prof Joly will be best remembered by his loyalty to the memory of Sir William Hamilton, of whose "Manual of Quaternions" he prepared a new edition. He endeavoured to promote the study of this branch of mathematics in various ways, by his original writings, in which he sought to bring projective geometry within this special method of treatment, and by the support he gave to the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics. We are also indebted to him for the third edition of Preston's "Theory of Light," while many papers in the *Transactions of the Royal Irish Academy* testify to his industry and power.

Prof. Joly was elected a Fellow of the Royal Society in 1904; he acted as secretary to the Royal Irish Academy from 1902, and was a member of many learned societies. He was a delightful companion, with a memory well stored with anecdotes of Hamilton, of Airy, of Robinson, and many another worthy; as a teacher he had the power of interesting his class and awakening their energies, and all too soon he is removed from a circle which he loved, and a society that his abilities adorned. W. E. P.

NOTES.

SIR MOUNTSTUART E. GRANT-DUFF, G.C.S.I., F.R.S., who died in London on Thursday, January 11, at seventy-six years of age, will long be remembered by his "Notes from a Diary"—a series of fourteen volumes full of chatty reminiscences extending from January, 1851, to January, 1901. Many distinguished men of science, both at home and abroad, were met by the author during this period of fifty years, and in each of the volumes of his diary are preserved interesting anecdotes and pithy remarks made by his acquaintances in the scientific world. Sir Mountstuart was fond of natural history, and particularly of botany, to which he devoted much attention. The 117th volume of the *Botanical Magazine* was dedicated to him by Sir Joseph Hooker "as a slight acknowledgment of the valuable services which you rendered to botany and horticulture when Under-Secretary of State, first for India and then for the Colonies, and lately when Governor of the Madras Presidency." He was president of the Royal Geographical Society from 1889 to 1893, and a member of the Senate of the University of London in 1891. By his spirit of investigation and sympathetic interest in scientific work—attributes not possessed by many statesmen—Sir Mountstuart secured the kindly feelings of all who are concerned with the study of nature.

WE regret to see the announcement that Dr. H. J. P. Sprengel, F.R.S., the inventor of the mercury air-pump which bears his name, died on Sunday, at seventy-two years of age.

A MEMORIAL to the late Dr. George Salmon, F.R.S., Provost of Trinity College, Dublin, was unveiled on Friday, January 5, in the national cathedral of St. Patrick's, with which Dr. Salmon was officially associated during the best years of his life. An account of the ceremony appeared in the *Kensington Express* of January 5, from which we learn that the memorial consists of two windows in St. Peter's Chapel, the work of Mr. C. E. Kempe, depicting scenes in the career of St. Peter, and a medallion of Dr. Salmon, by Mr. A. Bruce-Joy, with a Latin inscription of which the following is a translation:—"That the name of George Salmon may abide in the memory of mankind this monument has been erected by his faithful friends and grateful pupils. Fellow of Trinity College, Dublin—afterwards Regius Professor of Divinity, and finally Provost, he was for thirty-three years Chancellor of this Cathedral Church. A mathematician both adroit and powerful, he probed with keen insight the beginnings of Christian history, and specially the origin of the New Testament Books; as teacher and councillor he was unwearied in the service of the Irish Church. Shrewd, courteous, serious, kindly. He was born in 1819, and died in 1904. The fear of the Lord is the distinction of wisdom, and before honour is humility."

A GIFT of 1000*l.* has been received by the Royal Botanic Society from a fellow of the society, Dr. Robert Barnes.

THE widow and children of the late Dr. von Siegle, of Stuttgart, have presented 50,000 marks in memory of the deceased to the chemical institute of the University of Tübingen.

PROF. EMIL FISCHER has been elected president of the German Chemical Society for this year. Prof. S. Gabriel, Berlin, and Prof. W. Städel, Darmstadt, have been appointed vice-presidents in succession to Profs. O. N. Witt and H. Caro, who are retiring, whilst Drs. F. Mylius and A. Bannon have undertaken the duties of the secretaryship in succession to Drs. C. Schotten and W. Will. The post of librarian to the society, which hitherto has been held by Prof. Gabriel, has yet to be filled by the president. The society's funds are estimated at 762,635 marks, whilst the A. W. von Hofmann fund has nearly reached 45,000 marks.

AT Christiania on December 29, 1905, there gathered together under the presidency of Mr. John Sebelien a number of men interested in questions of agriculture and scientific subjects to celebrate the acquisition of a national independence in the past year. A fund was opened for the purpose of fostering research in the subject of Norwegian agriculture, to which fund all Norwegians, both at home and abroad, are invited to subscribe. When the sum of 15,000 kr. (833*l.*) has been subscribed, it is proposed to invite prize essays on particular questions, and to reward Norwegian scientific work in certain branches of learning; and later still it is intended financially to aid research work in agricultural science directly.

A REUTER message from Naples states that on January 10 three streams of lava were pouring down Vesuvius on the side upon which is situated Cook's funicular railway. The railway was seriously damaged, and the lava had reached the lower station. At the same date Etna was also active, a large amount of volcanic ash being ejected from the principal crater.

THE Geological Society of London will this year make the following awards of medals and funds:—Wollaston medal to Dr. Henry Woodward, F.R.S.; Murchison medal to Mr. C. T. Clough; Lyell medal to Prof. F. D. Adams, of Montreal; Prestwich medal to Mr. W. Whitaker, F.R.S.; Wollaston fund to Dr. F. L. Kitchin; Murchison fund to Mr. H. Lapworth; Lyell fund to Mr. W. G. Fearnsides and Mr. R. H. Solly; Barlow-Jameson fund to Mr. H. C. Beasley.

DURING this month and next an exhibition of studies and effects obtained by current methods of colour photography will be open at the office of the *British Journal of Photography*, 24 Wellington Street, Strand, W.C. The

aim of the exhibition is to show results produced without the intervention of half-tone blocks, or the aid of printing machines. Flower and fruit studies, portraits, and landscapes are represented by three-colour prints produced by various processes, and among the subjects of transparencies are stained glass windows, diffraction grating spectrum, micro-organisms and crystals, butterflies, and a Lippmann spectrum.

WE learn from the *British Medical Journal* that an international exhibition will be held under the patronage of the King of Italy at Milan on the occasion of the opening of the Simplon Tunnel. It will include a section of hygiene embracing general hygiene, public health, sanitary services, rural and industrial hygiene. The exhibition will be open from April to November. The third International Congress of Medical Electrology and Radiology will be held at Milan on September 5–9. Information as to membership may be obtained from Dr. Herschell, 36 Harley Street, London, W.

THE *Weekly Weather Report* of the Meteorological Office for the current year, which commenced with the issue of the report for the week ending Saturday, January 6, on Thursday last, has some novel features. The verbal description of the week's weather is placed in a more prominent position on the front page, and a table of the accumulated temperature, rainfall, and sunshine in the various districts for the aggregate of weeks from the commencement of the current season, winter, is given, in addition to the usual tables for the week and the aggregates from the commencement of the calendar year. In the table of detailed statistics for stations the groups of names included in the meteorological districts are subdivided to facilitate the compilation of values for the divisions of the country adopted for agricultural purposes by the Board of Agriculture. There is no change in the part of the report devoted to the daily summary of weather over Europe, but at the end, in place of the tables of addenda and errata, there appears an entirely new table of observations in the upper air. The first issue includes the observations by Mr. W. H. Dines at Oxshott on the 3rd, 4th, and 5th of the month, the days of international cooperation, and those of a kite ascent by Mr. C. J. P. Cave at Ditcham Park on the first day of the year. The last disclosed a remarkable temperature inversion, obviously in the region of junction between an eastern and western supply of south-easterly wind over the British Islands as shown on the maps. The juxtaposition of these observations and the maps showing the distribution of pressure over Europe make the inclusion of the week's results for the upper air in the report a very interesting feature, and it is to be hoped that in succeeding weeks the new development may be as fortunate as in its first number.

THE *Times* of January 6 contained an interesting account of despatches which have been received from the American travellers Mr. R. L. Barrett and Mr. Ellsworth Huntington, who are conducting an expedition in the Tarim basin. The explorers have fully studied some of the river systems between Khotan and Keriya, and made additions to our knowledge of the Tarim basin which bring out the striking resemblance of the basin to an inland sea. The examination of the ruins of abandoned villages appears to have thrown a good deal of fresh light on the gradual desiccation of Central Asia within historic times.

IN the issue of NATURE for August 13, 1903 (vol. lxviii. p 347), an illustrated account was given of the tetrahedral cell kites designed by Dr. A. Graham Bell. We learn from a Canadian contemporary, the *Halifax Herald*, that Dr. Bell thinks he is a step nearer the attainment of his ambition to perfect a flying machine based on the tetrahedral kite principle. A new kite, constructed of 1300 tetrahedral cells, having a total area of 752 square feet of silk, making a supporting surface of 440 square feet, carried to a height of 30 feet, in a recent trial, not only its own weight of 61 lb., but also a load comprising flying lines, dangling ropes, and a rope ladder, making 62 lb. more, together with a man weighing 168 lb., a total altogether of 291 lb.

IN the *Engineering and Mining Journal* of New York of December 23, 1905, there is a reproduction of the selected design for the United Engineering Building, the building presented by Mr. Andrew Carnegie to the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Engineers' Club. The site has a frontage of 125 feet and a depth of 100 feet. The contract for construction was signed in July, 1905, and the contract limit is fifteen months to the date of expected completion. The building will serve the convenience of the four societies mentioned, and is also to furnish accommodation for other societies that have engineering or some other department of science as their principal object.

THE disaster at Charing Cross Station at 3.30 p.m. on December 5, 1905, caused by the sudden snapping of the tie-bar in the truss next to the wind-screen at the southern end of the station has caused much perturbation in engineering circles, and is dealt with at considerable length in the engineering journals. An excellent illustrated description of the roof is given in the January issue of the *Engineering Review*, and photographs of the fracture of the tie-bar are given in the *Engineer* and in *Engineering* of January 12. The tie-bar was nominally $4\frac{1}{2}$ inches in diameter, and it was found that at the point of fracture there was an imperfect weld, the iron having been united properly over only about one-third of the section, so that the stress at that point was three times as great as it was designed to be. In fact, it was more than this, for the sound metal, being at one side of the line of tension, was subject to a bending force, and the state of affairs was somewhat similar to a notched bar under bending stress. The verdict given at the coroner's inquest on January 8 was to the effect that the accident was due to the breaking of the tie-rod through an unforeseen flaw, and that no blame was attached to any of the railway company's officials.

WE have received a copy of part v. of the "Marine Fauna of Ireland," published by the fisheries branch of the Irish Department of Agriculture, in which Mr. W. M. Tattersall discusses the isopod crustaceans. Some difficulty has been experienced in getting a good series of these creatures owing to the fact that the majority are not pelagic, and are, therefore, not taken in tow-nets. Nevertheless, the author describes no less than ten species as new, half of which are made the types of new genera, while one is regarded as representing a new family.

AMONG the numerous and varied contents of the *Proceedings of the Indiana Academy* for 1904, attention may be directed to a remarkably fine series of photographs of the nests and eggs—in some instances also the young—of a number of the birds of the district in their natural surroundings. Two of these are of special interest as showing the nest of the little green heron, first with eggs and then with the downy young. In many cases great difficulty

must have been experienced in getting the camera into position, and in some instances the whole side of a tree-stem has been cut away in order to show the eggs. Indian ceremonies form the subject of several articles at the close of the volume.

IN the course of an account of the Hastings Museum, Worcester, published in the December (1905) issue of the *Museums Journal*, the curator, Mr. W. H. Edwards, takes occasion to emphasise the extreme importance of the development of local collections. "If there are among my hearers," he observes, "any who are in the happy position of having charge of a newly started museum may I strongly urge them to make their local, or county collections, in all branches, as complete as possible, as no opportunity should be lost in acquiring specimens which have any bearing on the past history of a district." These views accord with those that have on more than one occasion been advanced in our columns. In a second article in the same issue it is somewhat amusing to find an author urging that a proposed new institution should be, as regards the exhibited series, "unlike ordinary museums, where, as far as possible, every species, and even varieties, are represented." In how many museums, "ordinary" or otherwise, is such a series displayed, and where is there one which would hold it?

THE whole of parts iii. and iv. of vol. xxxiv. of Gegenbaur's *Morphol. Jahrbuch* are occupied by a long essay on the tympanic region of the mammalian skull, by Dr. P. N. van Kampen, of Amsterdam. The article is an expansion of an address delivered by the author in Amsterdam in 1904. Within the space of a brief paragraph it is quite impossible to do justice to its contents, and it must in the main suffice to direct the attention of those interested in the subject to the mine of information it contains. It is interesting, however, to note that the author regards the primitive condition of the mammalian tympanum as consisting of a small and often incomplete ring, with, at most, an imperfect ventral wall to the tympanic cavity, and that a close approximation to this condition is presented by Ornithorhynchus. The tympano-hyal is the characteristic mammalian element in this region, but the ento-tympanic is also regarded as peculiar to the group, and unrepresented among the lower classes. As regards the tympanum itself, the author considers it to be a special development from one of the elements—probably the supra-angular—of the reptilian compound lower jaw. The features presented by the region are held to be of considerable value in classification.

THE Carnegie Institution of Washington has published a volume of 193 pages, by Profs. W. O. Atwater and F. G. Benedict, giving a description of a respiration calorimeter with appliances for the direct determination of oxygen. The apparatus has been in process of development for twelve years, and has been designed with a view to a proper understanding of the metabolism or transformations of matter and energy in the body, by obtaining a knowledge of both total income and total outgo. After describing the calorimeter and the methods adopted for the calculation of results, the experiments with man are considered. Since the completion of the new apparatus, twenty-two experiments with five different subjects, covering a total of sixty days, have been conducted. These experiments lasted from one to thirteen days, during which time the subject remained enclosed in the calorimeter chamber. In general, each experiment was preceded by a preliminary period outside the chamber, during which the subject was given the special diet to be tested, and his habits of life were so modified as to conform with those to be followed in the chamber. The following determinations of intake and output of material were made in the experiments:—The intake consists of food, drink, and oxygen from respired air. The amounts are determined by weighing. The output of material consists of products of respiration and perspiration, urine, and fæces. In the measurement of intake and output of energy the intake is derived from the potential energy, *i.e.* heats of combustion of the food. The output consists of sensible heat given off from the body, the latent heat of the water vapourised, and the potential energy, *i.e.* heat of combustion of the unoxidised portions of the dry matter of urine and fæces. In certain cases, *e.g.* work experiments, a portion of the output is in the heat equivalent of external muscular work.

IN the *Bulletin du Jardin impérial botanique* of St. Petersburg, vol. v., part iv., Mr. N. Busch describes a new Aconite, section Napellus, and a new Delphinium. Both plants were grown in the garden from seed collected in Tibet by Mr. W. T. Ladygin. A list of the known species of Iris from Turkestan is contributed by Mr. and Mrs. B. Fedtchenko, including several new species all belonging to the section Juno.

DR. B. M. DUGGAR, formerly a member of the scientific staff of the United States Department of Agriculture, has for some years been experimenting on better methods of propagation of mushrooms than the present chance method depending upon natural virgin spawn. His latest results are published in Bulletin No. 85 of the Bureau of Plant Industry. No more certain method for germinating the spores has been devised than that discovered by Dr. Margaret Ferguson of adding a portion of mycelium to the culture; but the latest experiments proceed on a new line of producing virgin spawn from pure cultures. A portion of the inner tissue of a young selected mushroom is transferred to a sterilised compost in tubes, and the mycelium produced in this way under pure culture conditions is sown on bricks of manure.

TWO recent numbers of the *Transactions of the Academy of Science of St. Louis* deal with botanical subjects. In vol. xiv., No. 7, Mr. B. F. Bush presents a summary of the species of Tradescantia from Texas, in which he adopts the view that certain forms referred to *Tradescantia virginiana*, notably *Tradescantia reflexa*, should rank as independent species. In vol. xv., No. 1, Dr. L. Wittmack writes on our present knowledge of ancient plants. He mentions that some of the wheat found in Egyptian sarcophagi and in Asia Minor shows the characters of the wild grain, and that the barley is of the variety *hexastrichum*, having six rows in the ear. From Peruvian sepulchres two kinds of bean have been identified as the Lima bean, *Phaseolus lunatus*, and the French or haricot bean, *Phaseolus vulgaris*. The author pronounces in favour of American origin for the latter.

IT will be known to readers of NATURE that one of the principal objects before the botanical congress held in Vienna last June was to formulate satisfactory laws for regulating systematic botanical nomenclature. A concise account of the main questions under dispute, and of the alternative suggestions put forward, is given by Dr. H. Harms in *Naturwissenschaftliche Wochenschrift*, December 10, 1905. There were three principal points of contention,

these being the earliest date for reference of priority, the extent to which priority of genus name should be observed, and how priority of specific name is to be decided. The year 1753, in which Linnæus first established his system of binomial nomenclature, was accepted as the critical date; the difficulty with regard to genera was settled by the confirmation of a list of names that are too well established to be superseded, while the decision in the matter of specific names was a compromise between the German practice of adopting the earliest name and the Kew rule that favours the first correct binomial.

The growing of Egyptian and other varieties of cotton is, says a writer in the *Pioneer Mail*, being carried on steadily in Upper Sind. It is indicative of the difficulty of forecasting the future of a transplanted variety that "Yannovitch," the finest of the Egyptian varieties, but regarded as the most delicate of those experimented with, has suffered the smallest amount of deterioration in staple from the quality of the Egyptian grown product, and that Mitaffifi, which is considered the most robust, has shown the greatest amount of deterioration. The general results must, however, be considered as satisfactory in yield as compared even with the Egyptian crop, and by the figures the best Egyptian variety should prove 250 per cent. more profitable to the cultivator than the indigenous Sindhi variety.

According to a writer in the *Journal of the Society of Arts*, the rubber industry continues to expand rapidly. The imports of rubber last year were exceptionally large, and throughout 1905 the price was better than in the preceding year. It may be expected that before very long the supply will be ample for all demands. Not only are there immense tracts of rubber which remain untouched in Liberia and elsewhere, but the cultivation of the rubber tree is being rapidly extended. Java, for example, is planting extensively, and within the next six or eight years the exports from that island are likely to be very large. In Ceylon, too, and the Malay Peninsula, considerable tracts of country are being planted with rubber. The way in which the tree adapts itself to the various climatic conditions obtaining in different countries is almost unique in tropical cultivation.

Of the life of a born naturalist no better example could be given than the account of the late Prof. Federico Delpino contributed by his pupil Borzì to the *Atti dei Lincei*, xiv. (2), 9. Born at Chiavari (Liguria) on December 27, 1833, Delpino's delicate state of health resulted in his spending much of his early life in a garden, where he soon became absorbed in observing ants, wasps, and flowers. In 1850 he commenced, by his own choice, a course of mathematics at the University of Genoa, but his love of botany prevailed, and he determined to make that subject his life work. After a sea voyage to the east, which gave him an opportunity of making a collection of the flora of the Dardanelles, he was employed in office work under the Minister of Finance at Turin, and later (1865) at Florence, where he soon resigned his post to take a subordinate assistant's position in the botanical museum. Four years later he was appointed professor at the school of forestry at Vallombrosa, and in 1875 he became associate professor of botany at Genoa. Later he held appointments at Bologna and Naples. He died on May 14 of last year. Delpino, who was entirely self-taught, became one of the pioneers in the study of vegetable biology. He was an ardent opponent of Darwinism, although a study of Darwin's work on orchids led to his first paper on fertilisation of the Asclepiadaceæ, published in 1865. Other important contributions dealt with the relations between plants and insects, particularly ants, and several of his results were confirmed by the observations of Belt in Nicaragua. In botanical geography he published writings on the distribution of the Ranunculaceæ, and on the relations between Arctic and Antarctic flora. Several of his writings have been mentioned in the "Notes" columns of Nature up to quite recently. Another account of his life is given in the *Rendiconto* of the Naples Academy for May and June, 1905, and differs in one or two points of biographical detail from the preceding one.

We have received a copy of the twelfth annual report of meteorology in Mysore, for the year 1904, compiled by Mr. J. Cook, director of the service. It includes the results obtained at the observatories of Bangalore, Mysore, Hassan, and Chitaldrug, with diagrams showing the range of the principal elements; also mean values for the twelve years 1893–1904. The data for this important Indian area are very carefully worked up, and the volume contains a large amount of valuable statistics.

The tides of the North Sea have within recent years been the subject of investigation by Mr. J. P. van der Stok, and the results have been published in three papers by the Netherlands Meteorological Institute, "Études des Phénoménes de Marée sur les Côtes Neerlandaises" (Utrecht: Kemink & Zoon, 1905). The first of these papers consists of an analysis of the variation in the level of the sea. The second deals with the results of observations, made on board the Netherlands lightships, of the tidal currents; and the third contains a table of these currents, the corresponding velocity and direction of the wind at five different stations, and the date of the new and full moon for every month up to 1952. Mr. Stok more particularly directed his investigation to the horizontal movement of the water and the rotatory currents in the North Sea. There are two subjects in connection with the tides of the North Sea that more particularly require consideration—the effect of the tidal wave of great length moving along the coast inclined to the direction of its propagation; and why the wave that comes from the north-east of Shetland is propagated principally along the coast of Scotland. This, he suggests, is due to the rotation of the earth. Mr. Stok considers that the tides of the North Sea are well worth the attention of physico-mathematicians interested in hydrodynamics, as they afford a model for the study of the mechanics of the tides.

In a paper on fluorescence (*Journal de Physique*, December, 1905), M. G. Camichel deduces from experiments and theoretical reasoning connected with them that the coefficient of fluorescence of a fluorescent substance remains constant during the period of fluorescence, at any rate under the conditions of the experiments.

In the *Journal de Physique* for December, 1905, MM. Bouasse and Berthier discuss the elongation of wires by flexion, in particular in connection with the property that a wire which is incapable of being elongated more than 0·1 per cent by simple traction can be lengthened by as much as 10 per cent. or 20 per cent. by bending. Observations of the changes of microscopic structure, as well as of the torsional rigidity of the wire at various stages of the processes, seem to indicate that this discrepancy is attributable to want of homogeneity in the wire, the effects of which disappear when the deformation is made to take place point by point along the wire.

In the *Bulletin des Séances* of the French Physical Society, M. E. Haudié gives a brief illustrated account of

the method of determining the magnification of an astronomical or Galilean telescope by photography. The telescope is placed in front of a camera pointed at a distant object (a church spire), and measurements of the telephotograph thus obtained, as compared with the picture obtained with the camera alone, give the magnification.

Of the many important topics discussed in the *Economic Journal* for December, 1905, we find a note of eight pages on political economy in Germany, by Prof. G. Cohn, of Göttingen. In it we learn that thirty or forty years ago there were two schools of political economy, namely, on the one hand, the Free Traders, whose science was confined to a few very elementary principles and who appealed to the people, and, on the other hand, the economic teaching of the universities. At the present time the universities, strengthened by the high degree of freedom which their professors enjoy, play an important and ever-increasing part in determining public opinion on economic questions throughout the Empire. Indeed, the author concludes:—"We do not claim too much for our German Political Economy and our German Universities when we say that the spirit which rules them is as wide and many sided as it is active and far seeing."

From the point of view of the disintegration hypothesis of the nature of radio-activity, a brief note by P. G. Costanzo in the *Bolletino Mensuale* of the Italian Meteorological Society (vol. xxiv., p. 25) is of interest; it is stated that several lavas and solid deposits from Vesuvius and the solfatara of Pozzuoli which, on examination, were found not to exhibit any sign of radio-activity were equally destitute of any trace of helium.

For his inaugural address, delivered on November 22 of last year, Prof. R. Threlfall, as chairman of the Birmingham section of the Institution of Electrical Engineers, chose the subject "Some Problems of Electro- and Electrothermal Chemistry." The principal question dealt with was the conversion of carbon into the "non-conducting" variety, and Ludwig's recent attempts to produce diamonds on the large scale were discussed, principally by considering theoretically the probable conditions governing the inter-conversion of the various forms of carbon. Other subjects touched upon included the fixation of atmospheric nitrogen, the ionic theory, and the use of osmium and tantalum in incandescent lamps.

The final number (No. 7) of the second volume of the *Central*, the magazine of the Old Students' Association of the Central Technical College, well maintains the high level of its predecessors. It contains a photogravure of Prof. Ayrton, president of the association, whilst a special feature is the large number of photographs illustrating the articles contained in it. Of these articles we may mention an interesting account by Mr. A. A. Barnes of the work recently carried out in excluding the Nile from two of its three channels at Ashmant for purposes of land reclamation; a summary by Prof. Armstrong of the various researches made on camphor at the college during the past twenty years, indicating the widely ramified growth of the problem; and a description of several types of electromagnetic ore crushers by Mr. C. J. Guttmann. Two photographs of a new camphor-model illustrate Prof. Armstrong's article.

A brief note by F. Giolitti in the *Gazzetta* (vol. xxxv. p. 181) contains some interesting particulars with regard to the coagulation of colloidal solutions of ferric hydroxide, the observations forming an extension of the earlier ones of Péan de St. Gilles. Whereas a trace of any polybasic acid, for example sulphuric acid, added to the colloidal solution obtained by boiling ferric acetate with water instantly precipitates a flocculent "hydrogel" which is insoluble in water, a considerable quantity of a monobasic acid such as nitric acid has to be added to the colloidal solution before a precipitate is produced. The product in this case is a reddish powder which re-dissolves in pure water, and is hence a "solid hydrosol." The quantity of monobasic acid necessary for complete precipitation of the solid hydrosol appears to be fairly definite for a definite set of conditions. The character of the colloidal solutions of a substance, however, seems to depend very largely on the way in which they are prepared. Thus a solution of ferric hydroxide prepared by dialysis according to Graham's method gives on coagulation very different results from those obtained with the solution prepared from ferric acetate. Moreover, other colloidal solutions, such as those prepared from ammonium uranate, plumbic acid, and silicic acid, have certain features which characterise their coagulation. It seems necessary, indeed, in considering the general question of colloidal solution, to recognise that several distinct types of coagulation exist.

The adhesion of electrical contacts in delicate seismoscopes continues to exercise the minds of Italian seismologists. No other form of seismoscope can be made so sensitive as one which records electrically, but the force tending to separate the contacts is so small that the circuit sometimes remains closed. In the concluding number of vol. x. of the *Bolletino della Società Sismologica Italiana* Dr. Agamennone reviews all the devices which have been proposed to overcome the adhesion, and concludes that the only efficient one is that suggested by Dr. T. Alippi, of attaching a vibrator to the seismoscope, which shall act like the decoherer in wireless telegraphy, but adds that his experience in the observatory at Rocca di Papa shows the necessity of carefully adjusting the energy of this vibrator. If too energetic it may produce the very evil it is designed to cure.

The annual report of the Iowa Geological Survey has just been published at Des Moines under the able editorship of Dr. F. A. Wilder, the State geologist. It deals with the year 1904, and forms a handsome quarto volume of 560 pages with 10 folding coloured geological maps of counties, 7 plates, and 51 illustrations in the text. In addition to the State mineral statistics for 1904, and reports on the geology of Benton, Emmet, Palo Alto, Pocahontas, Jasper, Clinton, and Fayette counties, the volume contains an important report on the Portland cement industry and Iowa's natural resources with reference to that material by Mr. E. C. Eckel and Mr. H. F. Bain. The report shows plainly that the limestones and clays of Iowa are well suited for the careful study of the cement manufactures. Despite the large amount of material available and the convenient fuel and transportation facilities, no Portland cement plants have yet been established in Iowa, although a number are in operation in adjacent States.

We have received from the Home Office an advance proof, subject to correction, of the statement of fatal accidents and deaths in and about the mines and quarries of the United Kingdom during 1905. The total separate fatal accidents were 955 in collieries, 41 in metalliferous mines, and 94 in quarries.

Mr. William Heinemann has in hand, under the title of "A Handbook of Metabolism," an English translation of the second German edition of von Noorden's "Lehrbuch des Stoffwechsels," edited by Dr. Walker Hall, of Manchester.

WITH the title the *Australian Journal of Science*, a new periodical edited by Prof. Liversidge, F.R.S., is to appear during the present month. At first the journal will be issued monthly, but afterwards, if it meets with sufficient support, at more frequent intervals. Literary correspondence, and publications for review, should be addressed to the Editor, *Australian Journal of Science*, The University, Sydney.

THE thirty-third annual dinner of old students of the Royal School of Mines will be held on Friday, February 16, at the Hotel Cecil. The chair will be taken by Prof. S. Herbert Cox; and the opportunity afforded by the dinner will be taken to make a presentation to Prof. J. W. Judd on his retirement from the chair of geology. Subscriptions for this testimonial should be forwarded before the end of January to Mr. D. A. Louis, 77 Shirland Gardens, W., to whom applications for tickets for the dinner should also be sent.

THE publication by Mr. George A. Morton, of Edinburgh, at 3*s*. 6*d*., of an attractive edition of Hugh Miller's "My Schools and Schoolmasters" should serve to re-direct attention to the work of a geologist whose writings were in the middle of last century the means of attracting many persons to the study of natural phenomena. A biographical introduction to the volume by Mr. W. M. MacKenzie provides an interesting study of Hugh Miller's career as stonemason, bank clerk, editor, geologist, and author, and reminds the reader that this work of his was published in 1854. The stonemason who by his own unaided efforts could attain to such an acquaintance with the rocks of his native land as to become the author of "The Old Red Sandstone" should prove an encouragement to all students of science who are working in the face of great difficulties. This new re-issue deserves a wide popularity.

A BOOKLET by Mr. J. El. David entitled "Le Tunnel du Simplon" has been published by Messrs. Payot and Co., of Lausanne. Parts of the account have already appeared as articles in the *Gazette de Lausanne*. In view of an article which appeared in NATURE of November 9, 1905, p. 30, describing survey work of the Simplon Tunnel, it is unnecessary to do more than refer to the contents of the brochure. Before publication the text was submitted to the chief engineers in charge of the work, so that the book may be read with confidence as containing a correct account of the order of events. The biographical notices and portraits of the engineers in charge of the gigantic undertaking, and other numerous illustrations, add greatly to the value of this essay.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c* (GIACOBINI).—A new set of elements and an ephemeris for comet 1905*c* appear in No. 88 of the Lick Observatory Bulletins; they have been computed by Mr. R. T. Crawford, of the Berkeley astronomical department, and the elements are as follows:—

$$T = 1906 \text{ Jan. } 22{\cdot}41845 \text{ G.M.T.}$$

$$\left.\begin{aligned} \omega &= 199^\circ\ 1'\ 28''{\cdot}8 \\ \Omega &= 92\ \ 2\ 00{\cdot}5 \\ i &= 43\ 38\ 36{\cdot}7 \end{aligned}\right\} 1906{\cdot}0$$

$$\log q = 0{\cdot}217605$$

The ephemeris shows that after perihelion (January 22) the comet's brightness will decrease rapidly, falling from 58·6 on that date to 22·7 on January 30. The positions (true) are given for alternate days during January, but only the three given below have been computed for dates subsequent to January 28:—

Ephemeris 0h. G.M.T.

1906	α (true) h. m. s.	δ (true) ° ′ ″	Brightness
Jan. 30·5 ...	21 53 28 ...	−25 44 25 ...	22·7
Mar. 1·5 ...	1 48 11 ...	−6 2 44 ...	1·5
April 2·5 ...	3 29 3 ...	+7 9 50 ...	0·3

Numerous observations of this comet are recorded in No. 4065 of the *Astronomische Nachrichten*. Dr. Jost, observing at Strassburg on December 30, 1905, found that the magnitude was about 5·0, and that the comet had a sharp definite nucleus and a tail about $\frac{3}{4}^\circ$ in length. On January 1 the magnitude was 4·0–5·0, the diameter of the nucleus 4″, and the length of the tail about $1\frac{1}{2}^\circ$.

A daily ephemeris, extending from January 13 to January 31, is given by Herr E. Strömgren in the same journal.

NEBULOSITY AROUND NOVA AQUILÆ.—Prof. Frost reports that a careful examination of the photographs of Nova Aquilæ No. 2, taken with the Bruce telescope at Arequipa on October 16 and 21, 1905, shows the Nova to be surrounded with a faint nebulosity nearly circular in form and extending to about 0′·4 on each side of the star. The exposure in each case was 120 minutes, and the nebulosity was independently confirmed by Mr. Manson.

As no such nebulosity appeared on the engraving given in vol. xxii. (p. 269) of the *Astrophysical Journal*, representing the Nova on September 21, 1905, Prof. E. C. Pickering suggests that it radiated from the Nova early in October, as was the case in Nova Persei No. 2. He points out, however, that, if it can be shown that the spectrum is peculiar, the apparent nebulosity on the Bruce photographs may be explained as being due to chromatic aberration which does not exist in the reflector, and would therefore not affect the earlier photograph (*Astronomische Nachrichten*, No. 4065).

THE FIGURE OF THE SUN.—Continuing his research on the variable figure of the sun, Dr. C. L. Poor has reduced the values of the solar diameter obtained by Schur and Ambronn, with the 6-inch Repsold heliometer of the Göttingen Observatory, during the thirteen years 1890 to 1902.

A detailed description of the methods of reduction is given in No. 5, vol. xxii., of the *Astrophysical Journal*, and the results tend to confirm those obtained in Dr. Poor's previous research, viz. that the ratio between the polar and equatorial radii of the sun varies periodically, the period being nearly the same as that of sun-spots. The amplitude of the variation is about 0″·2, the greatest difference between the extreme values of the quantity (polar−equatorial diameter) being 0″·5.

STELLAR MAGNITUDE OF THE SUN.—The results of an interesting research made by Prof. Ceraski at Moscow on the relative magnitudes of the sun and Polaris, Procyon, and Sirius, are given in No. 4065 of the *Astronomische Nachrichten*. During the day Prof. Ceraski photometrically compared the light received from Venus with that obtained from a reflected image of the sun, and then at night compared Venus with the stars named.

As a result he found that the sun sends us 290550×10^6 times more light than Polaris, 77630×10^6 times more light than Procyon, and 17045×10^6 more than Sirius. Taking the magnitudes of these stars as 2·15, 0·56, and −1·00 respectively, this gives −26·51, −26·66, and −26·67 as the stellar magnitude of the sun, and the weighted mean value becomes −26·59. As Prof. Ceraski objects to the obvious paradox in assigning a *negative* value to the sun's magnitude, he omits the *minus* sign and gives his result as "26·59 *super magnitude*."

VARIABILITY OF IRIS.—The results of a number of photometric measurements of the apparent brightness of Iris, carried out by Dr. H. Clemens during February and March, 1904, are given in No. 4063 of the *Astronomische Nachrichten*.

The lowest magnitude was recorded at 10h. 15m. (M.E.T.) on March 28, and was 10·34; the highest maximum observed (8·80) took place on February 9 at 8h. 46m. From the consideration of his results, Dr. Clemens concludes that Iris has a real variation of magnitude amounting to 0·25m.–0·30m., and having a period of approximately four hours.

SOME QUESTIONS FOR ARCHÆOLOGISTS.

THE study of a few of our British stone monuments from an astronomical point of view has led me to the conclusion that if such an inquiry be continued information will ultimately be obtained touching the order of succession of the various swarms of immigrants who set out the various systems of alignments. Approximate dates of the changes of temple worship representing different cults, and, therefore, possibly different tribes, have already been obtained, for I have evidence that the risings of stars, as well as of the sun, were observed in some of the circles. I also believe that much folklore and many myths may find their explanation.

I begin with the fact that some circles used in the worship of the May year were in operation 2000 B.C., and there was a change of cult about 1600 B.C., or shortly afterwards, in southern Britain, so definite that the changes in the chief orientation lines in the stone circles can be traced.

To the worship of the sun in May, August, November, and February was added a solstitial worship in June and December.

The easiest explanation is the advent of a new swarm of immigrants about that date.

The associated phenomena are that the May–November Balder and Beltaine people made much of the rowan and maythorn. The June–December people brought the worship of the mistletoe.

The flowering of the rowan and thorntree in May, and their berries in early November, made them the most appropriate and striking floral accompaniments of the May and November worships, and the same ideas would point to a similar use of the mistletoe in June and December.

Another associated phenomenon is that chambered barrows seem sometimes to have been used by the solstitial people instead of, or in addition to, stones to mark sight-lines.

If there were such swarms, and the June–December succeeded and largely replaced the May–November one, this could hardly have been put in a cryptic and poetic statement more happily than it appears in folklore: Balder was killed by mistletoe.

In the May–November circles and alignments we deal with unhewn stones. In the June–December alignments the stones in Brittany are tooled.

In this we have a strong argument in favour of the same order of succession.

The Worship Conditions and a Working Hypothesis.

In a colony of the astronomer-priests who built and used the ancient temples we had of necessity:—

(1) Observatories, *i.e.* circles, alignments, coves or holed stones, for viewing the alignments or sight-lines.

A study of the sight-lines shows us that the stones—collimation marks—were of set purposes, placed some distance away from the circles, so far that they would be required to be illuminated in some way for the dawn observations. When there was no wind, one or more hollows in a stone, whether a menhir or a quoit, might have held oil or grease to feed a wick. But in a wind some shelter would be necessary, and the light might have been used in a cromlech or allée couverte. Stones have been found with such cups, and débris of fires have been found in cromlechs.

(2) Dwellings, which would be cromlechs or many-chambered barrows, according to the number of astronomer-priests at the station, and possibly some arrangement for protecting a sacred fire.

(3) A water supply for drinking and bathing, which might be a spring, river or lake, according to the locality.

Assuming this, I ask whether we may not consider the following working hypothesis, the accuracy of which can be easily tested by those conversant with these subjects, which I am not; nor have I time to look over the vast and scattered literature where the facts are recorded.

Everything relating to these three different classes of things was regarded as very holy, because they were closely associated with the astronomer-priests, on whom the early peoples depended for guidance in all things, not only of economic, but of religious, medical and superstitious value.

Hence the circles, mounds and alignments, as sacred places, were subsequently used for burials, as Westminster Abbey has been; but burials were not the object of their erection by the first swarms.[1] I believe they were afterwards used for burials by later swarms, who imitated them, and built round barrows without living chambers for the dead.

The perforated stones were regarded as sacred, so that marriages took place at them, and passing through them was supposed to cure disease. Whether men and women, or children only, passed through the hole depended upon its size. But a hole large enough for a head to be inserted was good for head complaints. I may state that I have traced holed stones on May-November alignments. In too many cases the temples connected with them have been so ruthlessly destroyed that their use cannot so easily be established.

The cups for the light would also become sacred objects; have not many of them since been used for holy water?

The wells, rivers, and lakes used by the priests were, as holy places, invested with curative properties, and offerings of garments (skins?), and pins to fasten them on, were made at them to the priests, as well as bread and wine and cheese.

The fact that the tree on which the garment was hung was either a rowan or a thorn shows that these offerings commenced as early as the May November worship.

These wells are in many cases alongside cromlechs, circles or unhewn stones. In others they are near churches which have been built upon the sites of the more ancient temples.

At the coming of the June–December people all the old practices and superstitions were retained, only the time of year at which they took place was changed. As the change of cult was slow, in any one locality the celebrations would be continued at *both* times of the year.

The June–December people did what they could to favour their own cult by changing the old holidays, with the result that for long both sets of holidays were retained.

Since I have shown that the solstitial worship came last, as a rule traces of this would be most obvious in places where it eventually prevailed over the cult of the May year. In such places the absence of traces of the May festival would afford no valid argument against its former prevalence. In other places, like Scotland, where the solstitial cult was apparently introduced late and was never prevalent, we should expect strong traces of the May worship, and, as a matter of fact, it is very evident in the folk-lore and customs of Scotland.

The Conditions of Migration.

May we suppose that any of the races reached Britain by sea?

Some facts with regard to ancient travel are the following. Our start-point may be that Gudea, a Babylonian king who reigned about 2500 B.C., brought stones from Melukhkha and Makan, that is, Egypt and Sinai (Budge, "History of Egypt," ii., 130). Now these stones were taken coastwise from Sinai to Eridu, at the head of the Persian Gulf, a distance of 4000 miles, and it is also said that then, or even before then, there was a coastwise traffic to Malabar, where teak was got to be used in house-building. The distance from Eridu coastwise to Malabar, say the present Cannanore, is 2400 miles.

The distance, coastwise, from Alexandria to Sandwich, where we learn that Phœnicians and others shipped the tin extracted from the mines in Cornwall, is only 5300 miles, so that a voyage of this length was quite within the powers of the compassless navigators of 2500 B.C.

The old idea that the ancient merchants could make a course from Ushant to, say, Falmouth or Penzance need no longer be entertained; the crossing from Africa to Gibraltar and from Cape Grisnez to Sandwich were both to visible land, *i.e.* coastwise. The cliffs on the opposite land are easily seen on a clear day.

Hence it would have been easier before the days of astronomical knowledge and compasses to have reached

[1] "Les Celtes et les Gaulois dans les Vallées du Pô et du Danube," p. 82.

England, and therefore Ireland and the Orkneys, than to get to some of the islands in the Mediterranean itself; and the prevalence of solstitial customs in Sardinia and Corsica, with apparently no trace of the May year, tends to support this view, which is also strengthened by the fact that the solstitial customs in Morocco are very similar to those we read of in Britain.[1] The May year is unnoticed, and there is a second feast at Easter (March 16).

The May Year.

I traced the May year in Egypt at Thebes, the temple being that of Min, and the possible date 3200 B.C. Mr. Penrose showed that the Hecatompedon and the Archaic temple of Minerva at Athens were May temples, the dates of the foundations being 1495 B.C. and 2020 B.C. respectively; but the cult must have been there before the foundations; and the cult may well have come from Thebes, and I fancy it must have been all over the known world at the time. The warning stars at Athens were the Pleiades for temples facing the east, and Antares for temples using the western horizon.

But the equinoctial pyramid- and Babylonian-cult in vogue in Egypt in the early dynasties (4000 B.C.), with the warning stars Aldebaran (March) and Vega (September), was also represented in Greece at a much later period.

In Egypt generally, the solstitial worship followed that of the May and equinoctial years. The religion of Thothmes III. and the Rameses was in greatest vogue 2200–1500 B.C.

We find little trace of it in Greece proper, though Mr. Penrose has traced it in Calabria and Pompeii, and in some of the islands.

Because in the first glimpse of the May year we have dates from 3200 B.C. at Thebes, it does not follow that it did not reach Athens before 2000 B.C., because Mr. Penrose found a temple of that date. It is clear, also, that with the possibilities of coastwise traffic as we have found it, it might have easily reached Ireland by then; 2000 B.C., therefore, is a probable date for the May worship to have reached Britain, arguing on general principles; we now know as a matter of fact that it really reached Britain earlier.

May we assume, then, a traffic transferring even astronomer priests from *Egypt* to Britain at that date?

But why not *Greece* to Britain? Because by that time, as we learn from Mr. Penrose, the equinoctial worship from Babylonia had reached Greece as well as the May year from Egypt, and traffic from *Greece* would have brought *both*, but the equinoctial cult did not reach us then; there is no trace of Easter worship in the earliest stone circles.

The solstitial cult was born in Egypt; it is a child of the Nile-rise. I have shown in my "Dawn of Astronomy" that the long series of temples connected with the solstice may have commenced about 3000 B.C.; but for long it was a secondary cult; it was parochial until the twelfth dynasty, say 2300 B.C., Egypt's solstitial "golden age" may be given as 1700 B.C., and her influence abroad was very great, so that much travel, "coastwise" and other, may be anticipated. It is for some centuries after the first date that the introduction of the solstitial worship into Britain may be anticipated. It, for instance, is quite probable that the pioneers of sun worship should have reached Stonehenge in 2000 B.C., but the solstitial worship can only be proved after 1680 B.C.

A paper by Prof. J. Morris Jones on "Pre-Aryan Syntax in Insular Celtic" appears in the "Welsh People," by Rhys and Brynmor-Jones (Fisher Unwin), pp. 617–641. Prof. Jones was led to make the comparisons contained in it by the theory that the long-headed early inhabitants of Britain had migrated into Britain from North Africa. He finds that the syntax of Welsh and Irish differs from that of other Aryan languages in many important respects, *e.g.* the verb is put first in every simple sentence. Prof. Rhys had suggested that these differences represented the persistence in Welsh and Irish of the syntax of a pre-Aryan dialect, and as the anthropologists hold that the pre-Aryan population of these islands came from North Africa, it seemed to Prof. Jones that that was the obvious place to look for the origin of these syntactical peculiarities. He finds the similarities between Old Egyptian and neo-Celtic syntax to be astonishing; he shows that practically all the peculiarities of Welsh and Irish syntax are found in the Hamitic languages.

[1] Westermarck in "Folk-lore." Vol. xxi, p. 27.

This conclusion practically implies that the bulk of the population of these islands, before the arrival of the Celts, spoke dialects allied to those of North Africa. The syntactical peculiarities must have represented the habits of thought of the people, which survived in the Celtic vocabulary imposed upon them.

These conclusions were not known to me when I began to see the necessity of separating the cult of the June from that of the May years, and the identity of the conclusions drawn from astronomical and linguistic data is to me very striking, and also suggests further special inquiries.

The temple conditions in Greece investigated by Mr. Penrose, and on which the above generalisation is based, may be tabulated as follows:—

		Dec.	Day	Year
		° ′		B.C.
May Year.				
Archaic temple of Minerva	Pleiades	+ 7 50	April 20	2020
Hiero of Epidaurus, Asclepieion	,,	+ 9 15	,, 28	1275
Hecatompedon	,,	+ 9 58	,, 26	1150
Older Erechtheum	Antares (setting)	− 14 31	,, 29	1070
Temple of Bacchus	Pleiades	+ 10 35	,, 29	1030
Corinth	Antares (setting)	− 16 0	May 6	770
Aegina	,,	− 16 45	,, 7	630
Solstitial Year.				
June				
Athens. Dionysus (Upper Temple)...	Antares (setting)	− 11 2	June 20	1700
Pompeii (Isis)	β Geminorum	− 16 44	,, 19	750
December.				
Metapontum	β Geminorum (setting)	+ 29 38	Dec. 21	610
Locri	,,	+ 29 40	,, 21	610
Equinoctial Year.				
March.				
Nike Apteros	Spica (setting)	+ 6 10	Mar. 17	1130
Juno Lacinia (near Croton)	α Arietis	+ 7 27	,, 28	1000
Paestum (Neptune)	Spica (setting	+ 3 5	,, 22	535
Gergenti (Hercules)	,,	+ 2 30	,, 30	470
September.				
Rhamnus (Themis)	Spica	+ 6 0	Sept. 17	1092
Tegea (Minerva)	,,	+ 5 51	,, 18	1075
Syracuse (? Minerva) ...	,,	+ 4 30	,, 20	815
Athens (dedication unknown)	,,	+ 4 17	,, 23	780
Rhamnus (Nemesis)... ...	,,	+ 4 5	,, 22	747
Bassæ (Apollo)	,,	+ 3 57	,, 22	728
Ephesus (Diana)	,,	+ 3 57	,, 25	715
Syracuse (Diana)	,,	+ 2 22	,, 26	450
Ephesus (Diana) (re-orientation)	,,	—	Oct. 6	355
Special Orientations.				
Thebes ... ... The City of the Dragon (Cadmus, p. 830)	γ Draconis	+ 54 28	Sept. 20	1160
Eleusis (Ceres)	Sirius rising at midnight	− 18 0	,, 13	1400

Britain—Canaan.

Since we have traces of temple worship in Britain 1000 years before the building of Solomon's temple, it may be

useful to see what common practices can be gathered from Semitic and British traditions. We have common to both:—

(1) Worship in high places.
(2) Setting up of stones.
(3) Sacrifices with blood poured on the altar.
(4) Fire worship of Baal or Bel.
(5) Human beings passing through the fire.

The question arises, then, were not the circle builders Semites antedating the Aryans?

The Dolmen Builders.

Another matter of great interest is connected with the erection of dolmens in imitation of the caves first used for Semitic worship. The most philosophical study of this question I have seen[1] certainly suggests that much light may be expected from this source.

NORMAN LOCKYER.

THE SKELETON OF BRONTOSAURUS AND SKULL OF MOROSAURUS.

THE exploration of the American Jurassic by Cope and Marsh for remains of the Sauropoda practically began on an extended scale in 1877. It has been continued by these pioneers and their successors with some interruptions to the present time.

During this period a number of more or less complete skeletons have been found. The first was that of *Camarasaurus supremus*, a sauropod closely related to the Morosaurus of Marsh, found in the Jurassic of Colorado in 1877, and partially described by Cope. It was restored life-size by Ryder on large sheets of linen and exhibited, but never published. The skeleton is now being prepared for mounting in the American Museum of Natural History. The most complete skeleton known of Brontosaurus is the type of *B. excelsus*, Marsh, which was found in the Como Bluffs of Wyoming in 1879, and made the basis of Marsh's restoration of 1883, the first published. This beautiful specimen was unfortunately taken out before the method of removal from the matrix was as effective as it is now. It is, however, capable of being mounted, and will undoubtedly some day be one of the great ornaments of the Yale University Museum, in which it is preserved. In 1897 the American Museum party found the entire hind portion of the skeleton of a Diplodocus also in the rich region of the Como Bluffs. Two years later another skeleton of a Diplodocus, the best yet discovered, was secured by the Carnegie Museum expedition, and forms the chief basis of the great cast recently presented to the British Museum. In 1901 the Field Columbian Museum, of Chicago, secured another fine sauropod skeleton, the basis of the restoration by Dr. E. S. Riggs. It is termed Apatosaurus, a name which Dr. Riggs thinks preoccupies Brontosaurus.

In 1897 the American Museum expedition discovered the skeleton of the Brontosaurus or Apatosaurus represented in the accompanying photograph. It enjoys the distinction of being the first of the Sauropoda to be mounted from the original materials.

The field and museum work on this skeleton occupied the American Museum staff more or less continuously from 1897 to the spring of 1905. In 1898 and 1899 the excavation was carried on, and a little more than two-thirds of the entire skeleton was recovered. In the following year a few more vertebræ were found. The special features are the very large size of the animal, the absence of crushing of the bones, and the completeness of the ribs. The original parts are supplemented by bones and casts or models from other individuals. The chief parts entirely missing are the skull, which was restored partly from an imperfect skull of Brontosaurus, partly from that of the Morosaurus described below, the three anterior cervical vertebræ, the forearms of both sides from the shoulder down, which were restored from the Yale University specimen, the upper portions of the sacrum, the hind-limb of one side, and the terminal portion of the tail. The hind-limb and the tail were completed from other individuals in the American Museum of Natural History.

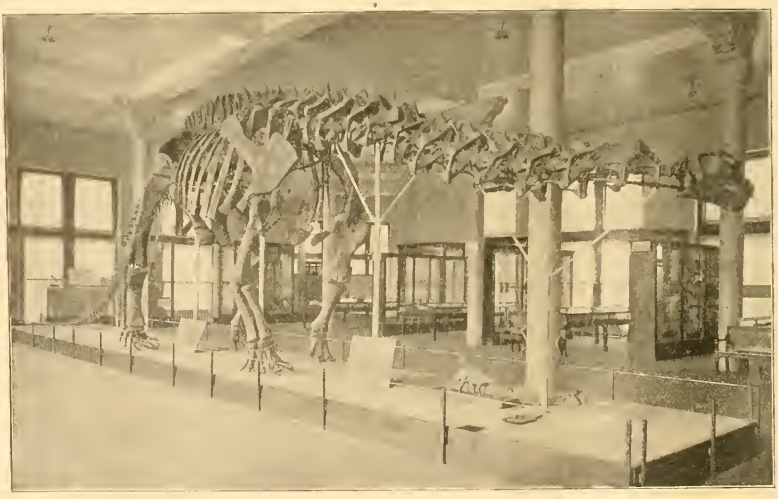


FIG. 1.—Skeleton of the *Brontosaurus excelsus* in the American Museum of Natural History, New York.

The mounting represents the prolonged work of very difficult restoration and the solution of a number of quite new mechanical problems for the support of the immense weight of the fossil skeleton without making the iron and steel work too obtrusive. For this the head preparator, Mr. Adam Hermann, deserves chief credit. A number of new anatomical problems arose, especially as to the position and angulation of the fore-limbs. In this

[1] "The Builders and the Antiquity of our Cornish Dolmens," by Rev. D. Gath Whitley (*Journal R.I. Cornwall*, No. l.).

connection the writer's assistants, Messrs. Matthew and Granger, made a complete restoration of the muscles of the shoulder girdle and of the neck on the basis of dissections of the alligator and lizard. As a result, two important modifications of previous restorations have been made, first, the scapula is considerably more depressed below the level of the back than in previous restorations, thus allowing space for the cartilages between the ribs and coracoid, second, the elbows are considerably everted.

In all previous restorations the manus is represented as provided with a nearly complete series of terminal claws like those of the pes, which lacks the terminal claw only on two digits. Comparison of ten specimens of Sauropoda in various museums has convinced the writer that, *according to present evidence,* in Diplodocus and Brontosaurus there is but one claw in the manus, and that a small one, on the pollex. The arching and elevation of the backbone also come in for considerable modification. Although, as previously supposed by the writer on other grounds, the sacrum was the centre of power and of motion in this great animal, as a result of the depression of the scapula the posterior portion of the neck and middle portion of the back were elevated, and the highest vertebra of the back is not necessarily the spine of the sacrum. Another characteristic of all Sauropoda is the elongation of the neck and the extreme abbreviation of the back, which now in several forms is found to be composed of from ten to eleven vertebræ only. Brontosaurus seems to differ from Diplodocus in the relative abbreviation of length as a whole correlated with the greater massiveness of the skeleton, but especially in the abbreviation of the tail.

	Cervicals	Dorso-lumbars	Sacrals	Caudals
Brontosaurus ...	13 est. ...	10 ...	5-6 ...	49 ± est.
Diplodocus ...	15 ...	11 ...	4-5 ...	35-40

In three specimens of Diplodocus evidence has been found of the consolidation of certain vertebræ of the tail (caudals, 17–18 and 19–21) at the point where they reach the ground. From this it has been inferred that the tail was used partly as a bracing or supporting organ when the anterior half of the body was elevated. There is no evidence of such consolidation in Brontosaurus, and the tail was relatively much shorter. Another difference is that in the tail of Diplodocus the vertebral spines are very lofty, and the transverse processes laterally compressed, indicating that this organ was partly used for propulsion in the water. These characters are much less strongly developed in the massive limbed Brontosaurus.

In this connection we may mention two partly antagonistic theories of the habits of this animal. First, the aquatic theory suggested by Owen in his original study of Cetiosaurus on account of the shape of the caudal vertebræ, and partly supported by Cope on the ground of the extreme lightness of the dorsal vertebræ; this has been more recently supported by Matthew and Gidley on the ground that the limbs were incapable of progression upon land, and were very much more strongly flexed than in any of the restorations of the animal which have been published. The amphibious theory has been partly developed by Cope and the present writer, namely, that the animals spent a considerable part of their life in the water, but were also capable of progression, and even of feeding, upon land; that during the reproductive and hatching period they spent a considerable time on land guarding their nests. A similar theory was advocated by Hatcher in his memoir on Diplodocus.

FIG. 2.—Skull of the *Morosaurus grandis.* 1/7 Natural Size.

The size of the Brontosaurus has been very generally overestimated. The chief measurements of the present skeleton as mounted are :—

	Feet	Inches
Length over all from head to tip of tail ...	66	8
Length of vertebral column	64	4
Length of neck...	16	10
Length of tail	31	4
Length of longest rib...	6	9
Length of hind-limb, including foot ...	10	7
Length of fore-limb, including foot... ...	8	6
Depth of body from lower end of pubis to top of posterior dorsal spine	8	7
Length of head as restored	2	4
Estimated weight of animal when alive ...	38 tons	

As above noted, the long-limbed Diplodocus attained a greater length; the specimen recently presented to the British Museum is 84 feet long. The little known Barosaurus, related to Diplodocus, was of still larger size, and the Brachiosaurus of Riggs had a much greater length of limb, but we have no means of ascertaining its length over all.

It is interesting to compare these measurements with those of a fully grown "sulphur bottom" whale, carefully measured by Mr. F. A. Lucas, and reproduced at the St. Louis Exposition. This animal, a male, measured 74 feet 8 inches from the notch of the flukes to the tip of the nose. The approximate weight of the bones was 17,920 pounds. The entire animal was estimated at not much less than 63 tons.

Our estimate of the weight of Brontosaurus is based on a model by Mr. Charles R. Knight on a one-sixteenth scale, founded upon the actual measurements of the present skeleton. As carefully estimated by Mr. W. K. Gregory

and Prof. William Hallock, of the physical department of Columbia University, the Brontosaurus displaced $34\frac{1}{4}$ tons of water. If the animal was slightly heavier than the water which it displaced, say 10 per cent., it would weigh 38 tons. Prof. Hallock thinks that an estimate of from 35 tons to 40 tons would be very near the truth, even allowing for errors of restoration.

Skull of Morosaurus.

Before the British Association at the Cambridge meeting the remarkable deposit of dinosaur remains known as the "Bone Cabin Quarry" was described. The quarry, which lies about nine miles north of the Como Bluffs, west of the Rockies in south-central Wyoming, is believed to represent a delta or mud and sand bar formation, in which were accumulated more or less complete remains of all the dinosaurs of the period.

FIG. 3.—Model of the Brontosaurus, by Charles R. Knight. Scale of Photo., 1/109. Scale of Model, 308 mm. high, 1/16 Natural Size.

One of the most rare and welcome products of this quarry in the continuous workings which began in 1897 and were recently completed have been the series of skulls, because the skull is the rarest and most fragmentary part of any of the Jurassic dinosaurs. They include one complete and two incomplete skulls of Diplodocus, two complete skulls of the carnivorous Allosaurus, one of Ornitholestes, the supposed bird-catching dinosaur, one of Laosaurus, a primitive iguanodont, one complete skull and portions of two other skulls of Morosaurus. This last is herewith described and illustrated for the first time. It was found at the end of a series of cervical vertebræ by Dr. W. D. Matthew in an extremely crushed condition, and its restoration required great skill and care.

Hitherto our knowledge of the skull of the Sauropoda has been limited to the single complete skull of Diplodocus and to the posterior portion of the cranium of one specimen of Morosaurus, both described by Marsh. These new materials, therefore, greatly expand our knowledge.

The most important point brought out is that all three skulls exhibit a well defined tubular opening on top of the skull at the junction of the parietals and paroccipitals. This foramen is smoothly lined with bone, and leads directly down into the cerebral cavity. It is thus probable that it lodged a large pineal eye, an organ the existence of which was left problematical by Marsh, as shown in the following passage:—

"There is no true pineal foramen, but in the skull here figured (Plate ii.) there is the small unossified tract mentioned above. In one specimen of Morosaurus a similar opening has been observed, but in other Sauropoda the parietal bones, even if thin, are complete." In Marsh's drawing the parietal opening is indicated rather as a fontanelle than as a foramen. While this opening is observed in the form of a bony tube in three skulls, it is of course possible that it was not invariably present in the Sauropoda, and that in some forms the foramen was partially or completely roofed over.

It will be recalled that the skull of Diplodocus has a long snout or antorbital extension supporting a series of slender, pencil-like teeth. The skull of Morosaurus differs widely from this type, first in the highly convex forehead or antorbital region, which is undoubtedly correlated with the presence of the great spoon-shaped cropping teeth, which were comparatively powerful and presented considerable resistance. Above, there are four premaxillary and eight maxillary teeth, decreasing in size as they extend toward the back of the jaw. From twelve to thirteen teeth are preserved in the mandible. The deep, massive proportions of the premaxillaries, maxillaries, and mandibular rami are also mechanically correlated with the insertion and powerful functions of these large teeth. It is evident, however, that as in Diplodocus the animal had no power of masticating its food, and that these anterior teeth served simply for prehensile purposes.

The anterior narial or respiratory openings are very large, facing forward rather than more directly upward, as in Diplodocus, while the openings in front of the orbits are correspondingly reduced. As restored in this specimen, the orbits are of enormous size, but considerable restoration was necessary in the bone surrounding this region, so that the contours of the orbits cannot be certainly ascertained. In the superior aspect of the skull it is evident that the frontal and nasal bones were much longer than in Diplodocus. It is noteworthy that the occiput or back part of the skull has practically the same composition as in the carnivorous Dinosaurs, namely, the parietals hardly enter at all into the top of the cranial roof except to bound the parietal or pineal foramen at the sides; this foramen, which is absent in the carnivorous dinosaurs, is bounded posteriorly by the supraoccipitals. The squamosals form the infralateral portions of the occiput. These resemblances tend, so far as they are of value, to sustain Prof. Seeley's view that the Sauropoda and Theropoda, or carnivorous dinosaurs, are more nearly related to each other (Saurischia, Seeley) than either are to the Predentata (Ornithischia, Seeley); in fact, it is possible to derive the sauropod type from a primitive quadrupedal theropod type, but not to derive either from an iguanodont type.

FIG. 4.—Model of the Diplodocus, by Charles R. Knight. Scale of Photo., 1/105. Scale of Model, 826 mm. long, 1/16 Natural Size.

HENRY FAIRFIELD OSBORN.

American Museum of Natural History, October 5, 1905.

THE PRESENT POSITION OF RADIO-ACTIVITY.[1]

THERE are three fundamental conceptions, the atom, the electron, and the ether. The seventy odd different kinds of atoms known, although fundamentally distinct, form a class to themselves in the complexity of matter, so that any discovery fundamentally affecting one must embrace all. The electron expresses for electricity the same idea as the atom does for any one kind of elementary matter, and may be termed the atom of negative electricity. Only one kind of electricity, and only one kind of electron, is known, and this possesses the same essential properties in all its various manifestations. The ether renders possible "action at a distance," and all actions transmitted through the ether are of essentially the same character and travel at one speed, namely, the speed of light.

The electron, although by origin an electrical conception, is in reality a material conception no less than the atom. At rest an electron is a simple charge—an electrostatic phenomenon. In motion it constitutes a current of electricity—an electromagnetic phenomenon. When an electron moves from rest to speed and back to rest again, the ether through which it moves at first has no magnetic qualities; then it acquires an amount of magnetic energy proportional to the speed of the electron, and then it again loses the same amount. Thus the electron cannot move without the expenditure of energy, and cannot be stopped until it has again given up the same amount. According to Newton's laws of motion, therefore, the electron is essentially a material particle. It possesses inertia, or "apparent mass," but it is not yet known whether it obeys the law of gravity, and possesses gravitational mass.

Since action at a distance travels through the ether at the speed of light, the magnetic field at a point some distance away from the line of motion of an electron cannot instantaneously accommodate itself to a change of motion of the electron, but the disturbance of the magnetic field travels outward from the electron with the speed of light. If the change of motion of the electron is periodic, as in the case of an electron revolving in an orbit within an atom, the disturbance constitutes ordinary light. In the Crookes's tube there is an irregular shower of free-flying independent electrons (kathode rays) upon the anti-kathode. The sudden irregular disturbances in the magnetic field travelling outward from the anti-kathode at the speed of light constitute the X-rays. The Hertz waves, on the other hand, result when electrons are caused to oscillate along paths of metrical rather than molecular dimensions, and their wave-length is measured in metres rather than in molecular diameters.

The apparatus employed largely to generate what are known to medical men as "high-frequency currents" admirably illustrate the inertia of electrons. Such a current will jump an air gap rather than traverse a spiral rod of copper, and will light a high-resistance incandescent lamp "short-circuited" by loop of bar copper. Lightning possesses the same characteristics, as Sir Oliver Lodge was the first to demonstrate.

The question arises whether there are two kinds of inertia, essentially similar, the one "material" and the other electromagnetic. If a sufficient number of electrons could be concentrated within a space of atomic dimensions, the total inertia of the aggregate could be made equal to that of an atom. Unfortunately, we know of no means whereby the mutual repulsions of the electrons could be overcome without introducing the hypothetical positive electron or its equivalent.

The present year is the decennary of M. Henri Becquerel's discovery of the natural radio-activity of matter. Radio-activity has been interpreted as the effect of a process of spontaneous disintegration occurring within the atoms of the radio-element, and already atomic disintegration is recognised as the probable cause of innumerable hitherto isolated phenomena in every branch of knowledge. It is the most fundamental and potent factor of evolution known. The ultimate cause of atomic disintegration, like that of most other common properties of matter, even gravitation, remains quite unknown. The view that radio-activity is the outward and visible sign of deep-seated material change followed from the elucidation of the nature of the emanations, and of the phenomenon of excited or induced activity. It was shown that the emanations and the allied bodies were new forms of matter continuously being *produced* from the radio-elements, and that they were the products of the changing atoms. Rutherford's discovery that the α radiation consisted of radiant particles, and the gradual accumulation of evidence, amounting to-day to practical proof, that the α particles are radiant atoms of the element helium, enabled the whole process to be simply elucidated. A single radiant atom is within the means of detection, for example, by the spinthariscope, whereas a million million atoms is not sufficient to be detected by the most delicate and refined spectroscopic test. The radio-atom suffers successive disintegration, and at each disintegration a single radiant particle is in general expelled. The radium atom successively expels five α particles, so that a residue of atomic weight about 205 should be left if these particles are helium atoms. There is strong indirect evidence for believing that the residue atom is that of lead. In the natural minerals, where the radio-elements occur, are to be found the ultimate products of ages of past accumulation. In the uranium minerals, helium, radium, polonium, and lead have been recognised as the constant companions of the uranium. Direct experiments have established in each case, except lead, the production of these elements during the disintegration. Polonium is the last changing member of the disintegration series, is a higher homologue of tellurium (Marckwald), and is identified with the radium F of Rutherford. The production of lead from polonium has not yet been directly observed, but Boltwood has shown it to be a constant constituent of the uranium minerals.

There is a comprehensiveness and subtlety in the operations of the laws of nature which the most vivid imagination cannot anticipate. The fact that the proportion of radium in any uranium mineral must be constant, being the ratio between the rate of disintegration of radium and that of uranium (or one to a million), cannot fail to have most important bearings. If to-morrow radium could be imported in quantity from outer space, after a few thousand years the quantity in the earth would be no more and no less than at present. By that time the quantity exhibited to-night will have had its day and ceased to be, but if the rest of the mineral from which it was extracted could again be examined a new amount no less than that originally present would be found to have grown in the interval.

How far are we justified in extending these ideas to explain analogous phenomena in the case of the inactive elements? We know that radio-activity is a mere accompaniment by no means essential to the process of atomic disintegration. The evidence available shows clearly that atomic disintegration might be universal and yet beyond the power of direct detection. A discovery fundamentally affecting any one element must embrace the whole class. The internal energy of the atom is merely revealed in radio-activity, in the same way as the internal energy of gun-cotton is revealed only when it explodes. The energy of the disintegration of an element is roughly a million times greater than that of any other change we are acquainted with. The attempt of the alchemist to build up a heavy element like gold from silver was futile, because, even if it could be done, it could not pay. The energy of some hundreds of tons of coal would have to be put into an ounce of silver to convert it into gold; but if gold could be formed from the degradation of a heavier element like lead, the gold would be a mere by-product, and the store of energy liberated simultaneously, however reckoned, would be of far greater value than the gold produced. At present we are totally ignorant of any means of altering or affecting in any way the rate of atomic disintegration proceeding spontaneously, or, in other words, we cannot effect artificial transmutation.

The experimental sciences do not hold out much hope of giving an immediate answer to the question whether atomic disintegration is general, and whether the scarcity or abundance of an element in the earth is a measure of its stability. We are forced back on such indirect evidence as lies ready to our hand. It is possible to obtain such evidence in the field of economics for the element gold,

[1] Abridged from the presidential address delivered to the Röntgen Society on January 4 by Mr. Frederick Soddy.

because gold has been established by long experience to be an excellent if not ideal metal for coinage. Analysing what this means, we find that an extremely complex condition must be satisfied. We are not a stereotyped or stagnant civilisation, and the demand for coinage metal experiences great fluctuations. With the scientific awakening of last century, an enormously increased demand arose in consequence of the rapid extension of commerce. In spite of this it is of the utmost importance that the value of other commodities expressed in terms of that of the coinage-metal must remain fairly constant from year to year, otherwise debtors and creditors might awake to find themselves ruined by some great variation in the value-ratio. Experience shows that this complex condition is, as a matter of fact, nearly fulfilled for the element gold. The first requirement that gold possesses enabling it to fulfil the condition is that it is a technically worthless metal. It possesses usefulness only on account of its value. Platinum, on the other hand, is unsuited for coinage because it possesses value on account of its usefulness. In the latter case the demand increases with fall of price, while in the former it decreases.

The second requirement that has to be satisfied if the value-ratio is to remain constant is that the output of gold should, on the average, bear some fixed ratio to the amount of human endeavour expended in the search. The scarcity must be relative, and some definite number of tons of the auriferous material must on the average be extracted to produce an ounce of the metal. That is to say, the scarcity must be mainly of concentration, as in the case of radium in the uranium minerals. If a technically worthless metal is a member of a disintegration series, so that its concentration in its ores is on the average fixed, it would obey the complex condition required for a coinage metal. So that the argument may be inverted, and indirect evidence obtained that gold is, like radium, a member of a disintegration series. The gold currency cost the world seventy million pounds worth of unproductive labour last year. A sum, which expressed in pounds runs into ten figures, representing the world's accumulated stock of bullion, has been *spent* in the past. To-day it exchanges at its face-value; to-morrow, with the introduction of a less expensive and more scientific system of book-keeping, it will become a mass of technically worthless metal.

This extension of the idea of atomic disintegration shows how powerfully the recent theories are bound in time to affect the life and thought of the community. Those who have grasped their significance know well that nothing appears the same or can again appear quite the same as before. It is not necessary that we should ever approach nearer than at present to the control and application of the new processes and reservoirs of energy. The mere possibility of being able to do so in the future cannot fail to leave its mark. By these discoveries the relation of mankind to nature has undergone a certain change, and man has caught a glimpse of some latent possibilities within his legitimate destiny which cannot be effaced. Energy is the life of the physical universe. You cannot multiply the existing store by a million and leave things as they were. Man, "nature's rebel," as Prof. Ray Lankester has depicted him, left isolated among the forces of nature to work out his own salvation, has had placed before his eyes a new material destiny. So far as physical possibility is concerned, he may one day attain to the power as well as the wish expressed in the quatrain of Omar:—

> "O love! could you and I with fate conspire
> To grasp this sorry scheme of things entire,
> Would not we shatter it to bits—and then
> Re-mould it nearer to the heart's desire!"

MEDICAL INSPECTION AND FEEDING OF CHILDREN IN SCHOOLS.[1]

WE welcome this extension of the inquiry begun in the physical deterioration report, however limited be the terms of reference, viz. (1) to report on what is being done, and with what result, in respect to medical inspection; (2) to inquire into the methods employed, the sums expended, and the relief given by various voluntary agencies for the provision of meals, and to report whether relief of this kind could be better organised without any charge upon the public funds.

(1) Upon the first subject, the results are shown to be most beneficial, the percentage of sufferers being by no means small; thus in defects of vision found in 7 per cent. to 20 per cent. of children examined, headache and apparent dulness often disappear. Twenty per cent. seems a common experience of the incidence of vermin, uncleanliness, and ringworm; here beneficial results have been generally of a marked character, cases being diminished by one-half in nine months in Gloucestershire.

The medical officer of health at Salford demonstrates to the teachers the symptoms to expect in infectious diseases, and the teachers are becoming so skilful in detecting symptoms, and at once excluding all suspected cases, that outbreaks of infectious disease demanding medical inspection are much less frequent. So will necessity for closing the schools diminish.

Diphtheria, it is stated, is now in several areas under such complete control that it can be stopped in a few days. We read in this and similar evidence an urgent call for the extension of medical inspection, and regret that the committee should water their conclusions with a comment that the "results" are to be given as statements of opinion rather than as ascertained facts. The contrary is the case, the facts are ascertained, and if the dozen witnesses coincide, surely we have progressed beyond opinion.

(2) In the second inquiry, in which the committee is to report whether relief can be better organised without any charge upon the public funds, much valuable sociological information has been collected. In many schools 2 per cent. to 5 per cent. of children require this aid, and a meal may cost from a penny to twopence. Seventeen recommendations outline business-like cooperation for charitable relief.

The committee has stated that in the ordinary run of cases which will come up to be dealt with, a woman's opinion upon the need of a household will be more valuable than a man's, and the opinion of two lady witnesses is given that the existing attendance officer is not sufficiently trained, and therefore of no use for the purpose. One would imagine a recommendation would follow that a lady official should be secured for this primary duty of selection of recipients. This omission does not seem explicable on financial grounds, for it might as readily be a charge upon voluntary subscription as upon the public funds. One feels that without such aid the frequent abuse of free meals, as reported in the evidence, is likely to recur.

In this inquiry, all who seek to avoid pauperising parents on the one hand, or the underfeeding of school children on the other, will find much useful information.

[1] Report of Interdepartmental Committee on Medical Inspection and Feeding of Children attending Public Elementary Schools. (Cd. 2779.) Price 1*s.* 3*d.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—By the will of the late Sir J. S. Burdon-Sanderson, the laboratory of the pathological department of the University is bequeathed the sum of 2000*l.*, payable within six months of his death, as an endowment to provide for pathological research there, the fund to be vested in the professors for the time being of human anatomy, physiology, and pathology, who are to have absolute discretion as to the application of the fund.

CAMBRIDGE.—Last Sunday completed the fiftieth year during which Dr. Atkinson has presided as Master over the fortunes of Clare College, and the University will on February 1 present him with an address of congratulation similar to that presented to the late Lord Braybrooke two years ago.

Mr. H. O. Jones, of Clare College, has been approved as deputy for the Jacksonian professor of experimental philosophy during the current Lent term.

The following awards to scholarships in mathematics have been made at Queens' College:—N. R. Krishnamma, Merchant Taylors', 45*l.*; C. F. Waterfall, Manchester Grammar School, 45*l.*; A. H. Pinder, Malvern College,

40*l.*; H. C. Bathurst, Dulwich College, 40*l.*; E. T. Lancaster, Exeter School, 30*l.*; G. D. Roechling, Winchester College, 30*l.*

The death is announced, at the age of forty-nine, of Dr. W. R. Harper, president of Chicago University.

The council of the University of Sheffield has appointed Dr. Louis Cobbett professor of pathology, and Mr. L. T. O'Shea professor of applied chemistry in the University.

Sir Michael Foster, K.C.B., F.R.S., will preside at the meeting of the Public Schools Science Masters' Association at Westminster School on Saturday, January 20, in place of the president, Sir Oliver Lodge, F.R.S., who is prevented from being present.

We learn from *Science* that at the recent special session of the State legislature the University of Wisconsin was again authorised to draw its income from the general fund of the State treasury, as according to the new method of appropriating funds for the university by setting aside two-sevenths of a mill on all taxes, the university income fund does not become available until February each year, whereas the university budget has always been estimated on the basis of the fiscal year, which extends from July 1 to June 30 of each year.

On Saturday, January 13, the first annual dinner was held of the past chemical students of the Technical College, Finsbury. Prof. R. Meldola, F.R.S., took the chair, and there were present, in addition to the lecturers and demonstrators of the chemical department, seventy past students of the college. Prof. Meldola referred with pride to the number of past students, who had won distinction in the chemical world, and were gathered around him. Finsbury was one of the earliest technical colleges, and had a record of a quarter of a century's usefulness to the technical industries of the country. Dr. Moody, who proposed "The College," said that this year was a very appropriate one for the first annual dinner, as their head, Prof. Meldola, now held the highest distinction the Chemical Society had to offer, the office of president.

A discussion has been opened in *L'Enseignement mathématique* on the reforms to be accomplished in the teaching of mathematics, and numerous mathematicians have been asked to state their opinions on the conditions that should be satisfied by a complete course of mathematics, theoretical and practical, in institutions of higher grade. The questions are as follows:—What improvements should be effected in the teaching of pure mathematics? What part should be played by higher educational institutions in preparing teachers for secondary schools? And how should mathematical teaching be organised in order that it may respond better than hitherto to the requirements of other branches of pure and applied science? Of those who have already taken part in this referendum, we note the names of Prof. Gino Loria (Genoa), Prof. Emile Borel (Paris), Prof. Jules Andrade (Besançon), Prof. D. E. Smith (Columbia University), Prof. F. Mariotte (Paris).

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, December 20, 1905.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—An exhibit consisting of about twenty photographs of diatoms taken by the Zeiss apparatus, designed by Dr. August Köhler, of Jena, for photomicrography with ultra-violet light: Mr. **Rheinberg**. The objective and other lenses used in taking the photographs were made wholly of fused quartz, which rendered possible the utilisation of ultra-violet light having a wave-length of 275 $\mu\mu$ (=275 millionths of a millimetre). The photographs were taken with a 1·7 mm. monochromatic objective of 1·25 N.A., using light from the cadmium spark. The resolving power was therefore as great as would be that of an objective used with ordinary light if it were possible to give it an N.A. of 2·5. There were photographs of *Surirella gemma* and *Amphipleura pellucida*; one of the latter taken with oblique illumination showed the diatom clearly resolved into dots. There were also comparison photographs of the same diatoms, taken with a 2 mm. apochromatic objective of 1·4 N.A. using light from the magnesium spark ($\lambda=383$ $\mu\mu$) giving about the same amplification, viz. about 1800 diameters. The difference in the appearance of the images was very apparent.—A fern fructification from the lower Coal-measures of Shore, Lancashire: D. M. S. **Watson**.

Linnean Society, December 21, 1905.—Mr. C. B. Clarke, F.R.S., vice-president, in the chair.—(1) An aposporous seedling of *Polypodium vulgare*, with a frond bearing a well defined prothallus at the tip. (2) A new case of apospory in *Cystopteris montana*: C. T. **Druery**.—The International Botanical Congress at Vienna in June last: Dr. A. B. **Rendle**. A report was given on the work of the congress, and in particular on the proposals of the conference on botanical nomenclature (see Nature, vol. lxxii., p. 272, 1905).—Cyrtandreæ Malayæ insularis novæ: Dr. F. **Kränzlin**.—On Characeæ from the Cape of Good Hope collected by Major A. H. Wolley-Dod, R.A.: H. and J. **Groves**.

Mathematical Society, January 11.—Prof. Forsyth, president, in the chair.—On the monogeneity of an algebraic function: Dr. H. F. **Baker**.—On the diffraction of sound by large cylinders: J. W. **Nicholson**.—On the expression of the so-called biquaternions and triquaternions by quaternary matrices: J. **Brill**.—Dr. E. W. **Hobson** made an informal communication On the representation of functions of real variables.

Paris.

Academy of Sciences, January 8.—M. Poincaré in the chair.—On a method allowing of the determination of the constant of an absolute electrodynamometer with the aid of an induction phenomenon: G. **Lippmann**. In the determination of the constant of an absolute electrodynamometer, the conditions imposed by the calculation if accuracy of measurement is aimed at are the opposite of the conditions for sensitiveness. In the method proposed in the present paper, the experimental measurement is reduced to finding the equilibrium position of a galvanometer, and measuring either an angle or a length.—On comets, and the curvature of their solar trajectory: Émile **Belot**.—On plane transformations: M. **Hadamard**.—On the non-stationary motion of a fluid ellipsoid of revolution which does not change its figure during the motion: W. **Stekloff**.—On the stability of aëroplanes and the rational construction of supporting planes: Edmond **Seux**.—On the variation of the emission spectra of some electric lamps with temperature: P. **Vaillant**. The lamps studied were the Cooper-Hewitt mercury lamp, the tantalum filament, the Nernst, and the ordinary carbon filament lamps. Figures are given showing the variations in the composition and intensity of the light with the number of watts consumed by each lamp.—On a new type of compound in the group of rare metals: C. **Matignon** and E. **Cazes**. At a high temperature samarium chloride, $SmCl_3$, is slowly reduced in a current of hydrogen to a lower chloride, the analyses agreeing with the formula $SmCl_2$. This lower chloride was obtained by other methods, the complete absence of moisture being the one condition essential. The chlorides of praseodymium and neodymium do not undergo a similar reduction by hydrogen.—The electrolytic preparation of spongy tin: D. **Tommasi**. The electrolytic solution is made up of stannous chloride (10), hydrochloric acid (1), and water (50), and the tin is deposited on a rotating kathode.—On cuprous-silicide: Em. **Vigouroux**. The author has repeated and confirmed his earlier experiments on this subject, and shows that in pure silicides of copper the amount of combined silicon is about 10 per cent.; the crystallised cuprous silicide, Cu_4Si, has been isolated and its principal properties determined.—The reduction of the chlorides of silver and copper by calcium: L. **Hackspill**. The reduction of silver chloride by calcium gives rise to a series of alloys of calcium and silver varying according to the proportion of calcium used. The reduction of cuprous chloride gave similarly a copper-calcium alloy.—Asymmetrical derivatives of 1:6-hexanediol; the diethyl ether and di-iodide of 1:7-heptanediol: R. **Dionneau**.—On the conditions of hydrogenation of some halogen derivatives of fatty hydrocarbons by the metal ammoniums. The preparation of ethylenic and acetylenic hydrocarbons: E. **Chablay**. Sodium, dissolved in liquid ammonia, acts

upon ethylene chloride quantitatively according to the equation $C_2H_4Cl_2+2NH_3.Na=2NaCl+C_2H_4+2NH_3$. The homologues of ethylene bromide give unsaturated hydrocarbons similarly, but there are secondary reactions. With compounds of the type $R.CHCl_2$, the alkali-ammonium reacts differently, giving the paraffin $R.CH_3$.—On the retrogradation and composition of natural starch other than potato starch: Eug. **Roux.**—The action of invertin in a heterogeneous medium: Victor **Henri.**—On solid solutions: Fréd. **Wallerant.**—On the secretory canals in the wood of Dipterocarpus: P. **Guérin.**—On the respiration of the flower: M. **Maige.**—The composition of the fluids which circulate in the plant; variations of nitrogen in the leaves: G. **André.**—On hordenine, a new alkaloid extracted from the germs of barley: E. **Léger.** The alkaloid forms anhydrous crystals of the composition $C_{10}H_{15}NO$. It is a strong tertiary base, forming easily crystallisable salts.—Hordenine, its degree of toxicity and symptoms of poisoning: L. **Camus.** This alkaloid is not highly toxic; death, when it is produced by a large dose, is determined by an arrest of respiration.—On the echinoderms collected by the French Antarctic Expedition under Dr. Charcot: R. **Kœhler.**—On the value of the magnetic elements at the observatory at the Val-Joyeux on January 1: Th. **Moureaux.**—Deep marine currents in the North Atlantic: A. **Chevallier.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—The Factors which Determine the Production of Intraocular Fluid: E. E. Henderson and Prof. E. H. Starling, F.R.S.—A Critical Account of some Anomalous Conditions of the Cerebrum in the Human Fœtus: Dr. W. L. H. Duckworth.—A Case of Regeneration in Polychæte Worms: A. T. Watson.—On the Infection, Histology, and Development of the Uredo Stage in certain Uredineæ: I. B. P. Evans.—On the Synapsis in Amphibia: J. E. S. Moore and Miss A. L. Embleton.—On the Constancy of Form among the Synaptic Gemini (Heterotype Chromosomes) in certain Animals: J. E. S. Moore and G. Arnold.—The Growth of the Oocyte in Antedon: a Morphological Study in the Cell Metabolism: G. C. Chubb.—Observations on the Life History of Leucocytes: C. E. Walker.—A Study of the Mechanism of Carbon Assimilation in Green Plants: F. L. Usher and J. H. Priestley.—Note on the Progeny of Chestnut Thoroughbred Horses: W. F. R. Weldon, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Refractive Indices of Crystallising Solutions with Especial Reference to the Passage from the Meta-stable to the Labile Condition: H. A. Miers and F. Isaac.—The Determination of Available Plant Food in Soils by the Use of Weak Acid Solvents. Part II.: A. D. Hall and A. Amos.—The Action of Ammonia and Amines on Diazobenzene Picrate: O. Silberrad and G. Rotter.—The Preparation of *p*-Bistriazobenzene: O. Silberrad and B. J. Smart.—Gradual Decomposition of Ethyl Diazoacetate: O. Silberrad and C. S. Roy.—Studies on Nitrogen Iodide. Part III. The Action of Methyl and Benzyl Iodides: O. Silberrad and B. J. Smart.—Silicon Researches. Part X. Silicon Thiocyanate: J. E. Reynolds.—The Relations between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—Halogen Derivatives of Substituted Oxamides: F. D. Chattaway and W. H. Lewis.—The Effect of Constitution on the Rotatory Power of Optically Active Nitrogen Compounds. Part I.: Miss M. B. Thomas and H. O. Jones.—Menthyl Benzene Sulphonate and Menthyl-β-Naphthalene Sulphonate: T. S. Patterson and J. Frew.—An Apparatus for the Continuous Extraction of Liquids with Ether: R. S. Bowman.—Action of Bromine on Benzeneazo-*o*-Nitrophenol: J. T. Hewitt and N. Walker.—Some Reactions and New Compounds of Fluorine. Part I.: E. B. R. Prideaux.—The Relation between Absorption Spectra and Chemical Reactivity. Part II. The Quinones and α-Diketones: E. C. C. Baly and A. W. Stewart.—The Relation between Absorption Spectra and Chemical Reactivity. Part III. The Nitroanilines and the Nitrophenols: E. C. C. Baly, W. H. Edwards, and A. W. Stewart.—Contributions to the Chemistry of the Rare Earths. Part I.: M. Esposito.—A Synthesis of Aldehydes by Grignard's Reaction: G. W. Monier Williams.—The Condensation of Dimethyldihydroresorcin and of Chloroketodimethyltetrahydrobenzene with Primary Amines. Part I. Monamines, Ammonia, Aniline, and *p*-Toluidine: P. Haas.

SOCIETY OF ARTS, at 4.30.—The City of Calcutta: C. E. Buckland.—At 8.0.—High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

LINNEAN SOCIETY, at 8.—The Life-history of *Margaritifera Panasesae*: A. W. Allen. On some Endophytic Algæ: A. D. Cotton.—Jacobson's Organ of Sphenodon: Dr. R. Broom.

FRIDAY, JANUARY 19.

ROYAL INSTITUTION, at 9.—Some Applications of the Theory of Electric Discharge to Spectroscopy: Prof J. J. Thomson, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Behaviour of Materials of Construction under Pure Shear: E. G. Izod (*Resumed Discussion*): Worm Contact: R. A. Bruce.

MONDAY, JANUARY 22.

SOCIOLOGICAL SOCIETY, at 8.—Sociology as an Academic Subject: Prof. R. M. Wenley.

TUESDAY, JANUARY 23.

ROYAL INSTITUTION, at 5.—Impressions of Travel in China and the Far East: Prof. E. H. Parker.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Resumed Discussion*: The Elimination of Storm-water from Sewerage Systems: D. E. Lloyd-Davies.—On the Elimination of Suspended Solids and Colloidal Matters from Sewage: Lieut.-Colonel A. S. Jones and Dr. W. O. Travis.

MINERALOGICAL SOCIETY, at 8.—Studies in Crystallisation: Prof. Miers and Mr. Chevalier.—The Chemical Composition of Geikielite: Mr. Jones and Mr. Crook.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. President's Address: Copper and its Alloys in Antiquity.

WEDNESDAY, JANUARY 24.

SOCIETY OF ARTS, at 8.—The Planting of Waste Lands for Profit: Dr. J. Nisbet.

GEOLOGICAL SOCIETY, at 8.—The Buttermere and Ennerdale Granophyre: Robert Heron Rastall.—On the Igneous and Associated Sedimentary Rocks of Llangynog (Caermarthenshire): T. Crosbie Cantrill and Herbert Henry Thomas.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experiments on the Chemical Behaviour of Argon and Helium: Dr. W. T. Cooke.—The Vapour Pressure in Equilibrium with Substances holding Varying Amounts of Moisture. Parts I. and II.: Prof. F. T. Trouton, F.R.S., and Miss B. Poole.—Note on Heusler's Magnetic Alloy of Manganese, Aluminium and Copper: Prof. A. Gray, F.R.S.—On the Overstraining of Iron by Tension and Compression: Dr. J. Muir.—On the Effect of High Temperature on Radium Emanation: W. Makower.—Observations and Photographs of Black and Grey Soap Films: H. Stansfield.—Artificial Double Refraction due to Æolotropic Distribution, with Application to Colloidal Solution and Magnetic Fields: T. H. Havelock.—An Electrical Measuring Machine for Engineering Gauges and other Bodies: Dr. P. E. Shaw.—The Relation between the Osmotic Pressure and the Vapour Pressure of a Solution: W. Spens. The Elliptic Integral in Electromagnetic Theory: Prof. A. G. Greenhill, F.R.S.—On the Simple Group of Order 25920: Prof. W. Burnside, F.R.S.

SOCIETY OF ARTS, at 8.—High Speed Electric Machinery, with Special Reference to Steam Turbine Machines: Prof. S. P. Thompson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering: F. W. Carter.

FRIDAY, JANUARY 26.

PHYSICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Prince of Wales Pier, Falmouth: T. R. Grigson.—Ferro-Concrete Pier at Purfleet: H. O. H. Etheridge.

CONTENTS.

THURSDAY, JANUARY 25, 1906.

HELIUM IN RELATION TO RADIO-ACTIVE PROCESSES.

Radio-activity. By Prof. E. Rutherford, F.R.S. Second edition. Pp. xiv+580. (Cambridge: The University Press, 1905.) Price 12s. 6d. net.

PROF. RUTHERFORD'S book has no rival as an authoritative exposition of what is known of the properties of radio-active bodies. A very large share of that knowledge is due to the author himself. His amazing activity in this field has excited universal admiration. Scarcely a month has passed for several years without some important contribution from him, or from the pupils whom he has inspired, on this branch of science; and, what is more wonderful still, there has been in all this vast mass of work scarcely a single conclusion which has since been shown to be ill-founded. The general scope of the present work has been noticed in these columns in a review of the first edition. Before passing to the discussion of special points, it is only necessary to say that the second edition fully maintains the reputation of its predecessor for completeness and suggestiveness of treatment.

It is natural to turn eagerly to the paragraph in which Prof. Rutherford discusses what may be called the burning question in radio-activity—Does the α particle consist of an atom of helium? Prof. Rutherford is evidently still inclined to the view that this is the case. He is influenced chiefly by the undoubted fact that helium is a product of the changes occurring in radium, by the approximate agreement in the electrochemical equivalent of the α particles with the value which is considered appropriate to helium atoms, and by the slowness with which the final products of radium are formed. This slowness seems to exclude the possibility that helium, which appears so soon, can be anything but a bye-product.

It is difficult to regard the argument from the electrochemical equivalent as having great weight, for the assumptions which must be made before available measurements can be brought to bear are many and bold.

In the first place, how do we know the electrochemical equivalent of a helium atom? In a case like hydrogen or oxygen we are on safe ground, for experiments on the electrolysis of its compounds enable us to compare the quantity of electricity conveyed with the amount of the element liberated. But no such experiment can be made with helium, for it forms no compounds. It is evident, therefore, that the desired information can only be got by some indirect argument. Unfortunately, the most obvious kind of induction does not lead us to a very satisfactory conclusion. It is found that if we call the charge which a monovalent atom can carry e, then a divalent atom will carry a charge $2e$, a trivalent atom a charge $3e$, and so on. What, then, are we to expect of an atom like helium, which, so far as can be judged from its chemical behaviour and from its position in the periodic classification, has zero valency? Obviously that it should not be able to carry a charge at all in the same sense that the other atoms can do so.

Helium, like other gases, can be ionised by the Röntgen rays, so there is reason to think, from this point of view, that its atom can in some sense be charged.

It has been customary to assume that the appropriate charge to assign to it is that of a monovalent atom. This may be the best view to take provisionally. But further light is much needed.

Again, we have no very direct measurement of the charge carried by an α particle. Prof. Rutherford assumes for that case also the charge characteristic of a monovalent atom, and he has been able to calculate on this assumption the volume of radium emanation and the heating effect of radium. The results in both cases are in satisfactory agreement with experimental data, and Prof. Rutherford is to be congratulated on his remarkable success in showing that such agreement can be obtained. But he would not, in all probability, press the exactness of this agreement as sufficient evidence that the charge of an α particle is exactly that assumed, and not either half or double, for he has had to use many data which cannot but be considered subject to very serious uncertainty. Indeed, the agreement obtained is so good that even if all the premises are correct it must be considered as to some extent fortuitous.

Perhaps the most original chapters in Prof. Rutherford's book are those in which he has so admirably disentangled the complicated series of changes which are involved in the disintegration of radium and its emanation. The idea at one time entertained that radio-activity was determined by high atomic weight must now be abandoned. For it has been made quite clear by these investigations that changes characterised by low radio-activity and slow atomic disintegration are followed by others of far greater rapidity. Radium, in losing atomic weight, turns into the emanation, which, weight for weight, is far more active than its parent.

In the appendix some interesting properties of the α rays are described. This branch of the subject is, however, at present in a very chaotic state, and we shall not discuss it here. One remark may be criticised—nearly the last in the book. Prof. Rutherford thinks that ordinary matter may be emitting as many or more α particles than uranium, if only the velocity of these is less than that minimum velocity which has been found necessary to produce the characteristic phenomena. This is scarcely consistent with the facts if the α particle is a helium atom. For why, in such a case, is helium only found in appreciable quantity in radio-active minerals?

In conclusion, we must once more congratulate Prof. Rutherford on the admirable manner in which he has brought his book up to date, and express a hope that the present edition may have many successors.

R. J. STRUTT.

AN ESSAY TOWARD THE "PRIMA PHILOSOPHIA."

The Metaphysics of Nature. By Carveth Read. Pp. viii+354. (London: A. and C. Black, 1905.) Price 7*s.* 6*d.* net.

CRITICAL philosophy or metaphysics Mr. Read divides into two branches, the metaphysics of nature and science and the metaphysics of ideals. In this work he deals only with the former branch, and only with the most general principles of science. He makes it a rule "not to attempt to solve *a priori* any problem that can only be effectually treated by inductive methods." He discusses in the introduction the meaning of terms like belief and knowledge, reality and truth. Then in Book i., entitled "Canonic," he considers various tests of truth, different forms of scepticism, and the great problem of the relativity of knowledge. Book ii.—"Cosmology"—deals with the doctrine of substance. Book iii.—"Psychology"—deals on the same lines with the subject of experience; while the last book—"The Categories"—discusses relation, the physical categories, and the categories of subjective activity.

The author's beliefs on two of the most general of metaphysical problems may be most concisely stated in his own words. Thus on p. 240 he writes:—

"I am recommending as the most coherent and natural way of thinking, on the whole, this hypothesis that the world is essentially a conscious thing; that in consciousness we have immediate knowledge of Reality, but not of the whole of Being; that the rest of Being is made known to us by phenomena; that it is everywhere conscious, but in various degrees, and that the higher degrees are known to us by the phenomena of organisation."

Again, in dealing with the teleological problem on p. 348:—

"Frankly, I wish it were possible to prove or make credible the teleology of Nature, because we might then follow Aristotle in identifying the End of Nature with the End of Humanity; but I cannot help feeling that the weight of argument is against the doctrine of Final Causation. Like transcendent Being, it remains a merely indicative, orectic category."

The influences to which Mr. Read most readily responds are Hume, Spinoza, to some extent Spencer, and, of course, modern science. The defences of Hume often bring out points too apt to pass unnoticed. Thus Hume's "custom" is described as "intuitive reason in the making." Mr. Read, who has a lurking affection for the sceptical—*e.g.* he thinks that the scepticism of the new academy was superior, even as philosophy, "to the fanatical dogmatism of the Stoics and to the gaseous hypotheses of the Epicureans"—points out the elements of Hume's philosophy which were clearly sceptical, but lays over against them the facts that scepticism was partly a disguise with Hume, and that even Hume puts forward pragmatism as the natural remedy for scepticism.

Hume's great follower or controverter, Kant, receives interesting treatment. Mr. Read refuses to join in the "hysterical outcry" against the thing-in-itself; but he finds abundant cause for complaint in Kant's mythological method of arguing from the unity of consciousness to a substance, a "thing" that "forms an idea." Kant's famous statement is quoted:—"If there is no *Urwesen* distinct from the world, if the world is without a beginning and therefore without a Creator, if the will is not free, then moral ideals and principles lose all their validity"; and Mr. Read adds, "It is impossible to find in literature a more desperate sentence than this, or a more false."

One welcomes the clear distinctions drawn in the introduction, chapter ii., between empirical, physical, transcendent, and noumenal reality; the defence, too, of much-abused eclecticism on the ground that after all the great systems in philosophy are themselves patchworks. And unless one is wedded to the theory that philosophy must be dull if it is to be sound, one rejoices in the good sayings—often as sensible as they are pungent—with which the book abounds, such as—"Future generations may have reason to thank those who left them something to do, more than those who anticipated everything," or the description of Hegel's rationalism as only an unintelligent empiricism. But no short notice like this can do justice to the closeness of the argument, the soundness and comprehensiveness of a book which must be ranked among the most important of recent years.

There are one or two animalcules in the ointment. Locke's great work is referred to as "Essays of Human Understanding"; and in talking of Hume's "Treatise" the author gives references to the parts only, forgetting that there are in it books divided into parts. Words like *verbile, questionnaire, glissaded,* do not find favour with all readers. An index might well have been provided, but its absence finds much compensation in an excellent table of contents.

MATHEMATICS FOR THE LABORATORY.

Higher Mathematics for Students of Chemistry and Physics, with Special Reference to Practical Work. By Dr. J. W. Mellor. Second edition, enlarged. Pp. xxi+631. (London: Longmans, Green and Co., 1905.) Price 15*s.* net.

THIS is the second edition of a book which from the first was recognised as filling a place of its own in our mathematical literature. It is essentially a book for the student of chemistry, for whom a smattering of mathematics used to be supposed to be sufficient. The result was that our college curricula made no provision for training chemists in the mysteries of the calculus, at least no compulsory provision. When at length the eager student came in touch with modern work, say, on the velocities of reactions, or on thermodynamic developments in general, he encountered mathematical methods and even notations quite unfamiliar to him. What was he to do? Go and quaff the heavenly nectar provided by Williamson or Lamb? But this, we learn from Dr. Mellor's preface, brought perplexity rather than clearness of vision. What the student of chemistry wanted was a working knowledge of the methods of the differential and integral calculus, with a minimum

of theory and demonstration. The student of physics is somewhat differently circumstanced. From time immemorial physical research and mathematical methods have been more or less closely associated, and every student of physics knew that a certain knowledge of higher mathematics was demanded of him. Yet complaints have been heard even from him that the mathematical courses in our colleges lacked a certain flavour of the real, and were not particularly suited to his needs. It has often been said that there is no royal road to mathematical knowledge. To quote Dr. Mellor himself, a certain amount of drudgery is necessary in some stages. But some roads are easier than others; and in this book chemical and physical problems are introduced, like rest houses along a weary way, to cheer the flagging traveller. Here he finds familiar food for his mind. To change the metaphor, the student is given a new weapon, and at the same time is taught how to use it on material already his.

To what extent the reader, otherwise ignorant of the principles of the differential calculus, will be able to appreciate the first chapter, experience alone can tell. The introduction of sections on proportionality and logarithms in the middle of the discussion of differentiation does not strike one favourably. The author's reference to this in the preface may, however, be accepted as sufficient excuse.

The new edition is fundamentally the same work as the old, but about a fifth more bulky. The increase in size is due partly to a more sparing use of small type, but chiefly to the introduction of new matter. There is also a good deal of re-arrangement of individual sections, such, for example, as the carrying forward of the paragraphs on the Gamma and elliptic functions from chapter iv. (the integral calculus) to chapter vii. (how to solve differential equations). From a physical point of view this is undoubtedly the better arrangement; and there is a further improvement which deserves notice, namely, the leading up to each of these functions by the discussion of a comparatively simple dynamical problem. The most obvious addition is the new chapter on the calculus of variations, in which brachistochrones and isoperimetrical problems are touched upon. Probably the main service rendered by this chapter will be to enlarge the outlook of the student. The class of readers for whom the book is ostensibly written will hardly ever be called upon to apply the calculus of variations, and if they should be they would find the discussion too meagre for them to make effectual use of it; but it is a real service to open a man's mind to the things which lie beyond the immediate purpose of his life. The still too common utilitarian idea that the practical man should be taught just as much mathematics as we know to be necessary for his immediate needs is an idea which cannot be too strenuously contested. The truth is, we never know what will be needed before the year is out. The chemist of the last generation would as soon have thought of studying the properties of Theta functions as of familiarising himself with the modes of solution of the simpler differential equations, or even with the meaning of a differential coefficient; but that attitude of mind is impossible now. The theoretical chemist of the rising generation must know his mathematics, and we are convinced that many will bless Dr. Mellor for providing them with an eminently readable and thoroughly practical treatise.

Throughout the book there are many historic notes which are always interesting in their way. It will not, then, be thought amiss to direct attention to the section on pp. 59 and 60, and to ask why writers are so slow to do Newton justice in regard to his so-called law of cooling. It is now six years since Prof. Crichton Mitchell, in a paper on the convection of heat by air currents (*Trans. R.S.E.*, vol. xl. p. 39), pointed out, what seems to have escaped the notice of every commentator except Fourier, that Newton deliberately placed his cooling body "non in aere tranquillo, sed in vento uniformiter spirante." Dulong and Petit, therefore, and all their copiers, including Dr. Mellor himself, are not giving "a typical example of the way in which the logical deductions of an hypothesis are tested" when they try to apply Newton's law to a body cooling in tranquil air. Crichton Mitchell showed that when Newton's conditions were realised Newton's law held with wonderful accuracy over a considerable range of temperature differences.

C. G. K.

PLANT DISEASES.

Minnesota Plant Diseases. By Dr. E. M. Freeman. Pp. xiii+432. (St. Paul, Minnesota: The Pioneer Press.)

THIS publication is issued for "the people of Minnesota" by authority of the university of that State. It may have special reference to a particular State, but it is quite evident, from a perusal of its pages, that the book will be of service wherever plants are cultivated. The author takes a broad view of his subject, and rightly considers the prevention of disease as a more important matter, from the point of view of the cultivator, than the application of remedies. "Agriculture," says he, "really resolves itself into one great problem, the prevention of plant-disease." Keep the "patient" in good health by careful attention to his physiological requirements, by cleanliness and by strict compliance with the teachings of hygiene. Much more good will ensue from these measures than from the use of insecticides or anti-fungus sprays. A knowledge of the life-history of the plant, as well as a corresponding familiarity with the mode of life of the hostile insect or fungus, is, indeed, essential, but unless combined with the faculty of turning that knowledge to account, the information is, practically speaking, of no value.

The first question that is asked when a diseased specimen is submitted is, "What is the matter with this plant?" The next, and in the view of the questioner the most important, is, "What am I to do to get rid of the disease?" Not one in a hundred cucumber-growers, cultivators of the vine or other crops, asks a question as to the methods of preven-

tion; the ninety and nine ask for a "cure." Yet whilst prevention is often within reach, cure, in the proper sense of the word, is frequently impossible. The diagnosis of the disease must be left to the skilled expert, the means of prevention should be known to all intelligent cultivators, the remedy may be prescribed by the plant-doctor, whilst the "cure," which often means the bonfire, may be entrusted to the labourer.

Another point which cannot be overlooked in considering the prevention of epidemic diseases is the necessity for concerted action. If one cultivator is alive to the exigencies of the case his labour is often vain if his neighbour be slovenly and apathetic.

The book before us is divided into two parts, the first dealing with the fungi which are injurious to plants generally, the second with the specific diseases of Minnesota vegetation. The account of the nature, mode of growth, and habits of fungi is written clearly and in a style readily comprehensible by the reader of average intelligence. It forms, indeed, an excellent introduction to the study of fungi.

A separate chapter is given to the history of the bacteria which presents in a concise form many details of the utmost importance to cultivators. After these generalities attention is directed to the fungous diseases most prevalent in Minnesota. To these we need not here specially refer, nor to the sections on fungicides and spraying apparatus. We can only add that the book is well illustrated and provided with a copious index. We commend it to the notice of all who are interested in plant-diseases, and especially to foresters and cultivators of field or garden plants.

OUR BOOK SHELF.

Mesure et Développement de l'Audition. By Dr. Marage. Pp. 119. (Paris, 1905.)

THIS small volume by Dr. Marage is of scientific value inasmuch as it contains an account of a method by which acuteness of hearing can be measured, and by which any degree of deafness can also be stated with accuracy. Aurists for many years have made use of the ticking of a watch, the sound of a tuning-fork, or a percussion sound as a source of sound, and they state the degree of deafness by a measurement of the distance at which the patient can hear the sound as compared with the efficiency of a normal ear. The best of all acoumeters, no doubt, is the human voice, as it gives sounds to which the ear is adapted; but no two human voices are alike, in consequence of the variations in quality caused by the vocal resonating cavities.

Dr. Marage, however, has invented a siren which is furnished with resonating masks (casts of the vocal cavities as adapted for the vowels OU, O, A, E, and I). This apparatus utters these vocal tones with singular purity. The form of the mask, and especially that of the oral opening in each case, suppresses most, if not all, of the overtones for each vowel, and the laryngeal vowel tone (produced by the siren) is alone sounded. Further, he has shown that the intensity of the sound of this instrument, as measured by a special water-manometer, is proportional to the pressure of the air which traverses the apparatus. The siren can be adjusted for any vowel, and the apparatus is always at the same distance from the ear. The measurement of the auditive acuity is given in the number of millimetres of water shown in the manometer when the sound of the particular vowel is heard. Thus any vowel sound is heard with a pressure of 1 mm. by a normal ear; if the pressure must be raised to 40 mm. before the sound is heard the auditive acuity is 1/40, if at 60 mm. 1/60, if at 200 mm. 1/200, and so on.

Dr. Marage also shows an ingenious method of recording on a chart the degree of acuity for each vowel, always in mm. of water, and if the points for the various vowels are joined a curve is produced. The form of this curve varies with different pathological conditions of the middle and internal ear, so that after the patient's ear has been tested for the vowel tones by the siren, and the curves have been plotted out, the form of the curve is of value in diagnosis. Lastly, Marage uses the siren to massage the drum-head and chain of bones by giving to the ear for a certain time, say a daily massage of ten minutes, using the vowel tones of the instrument, and he asserts, and shows by charts, that in a large percentage of cases of many forms of ear trouble, and in some cases even of deaf mutism, there is benefit derived from the massage treatment. These results cannot be criticised in a scientific journal, as they pertain more to the region of the practical aurist, but there can be no doubt of the value of the method of Marage as a method of accurately determining acuteness of hearing. JOHN G. MCKENDRICK.

American Insects. By Vernon L. Kellogg. Pp. vi+674; 812 illustrations and 13 plates. (New York: Holt and Co.; Westminster: A. Constable and Co., Ltd., 1905.) Price 21s. net.

THIS work is intended as an introduction to North American entomology. It consists of a systematic review of the various orders of insects met with in America north of Mexico, and of introductory and supplementary chapters dealing with special subjects. The three introductory chapters on structure, physiology, development and classification are well done, a great deal of information being condensed in these 50 or 60 pages.

The supplementary chapters are, however, the best part of the book. They are (1) insects and flowers; (2) colour and pattern and their uses; (3) insects and disease. These subjects are treated in an intelligent manner, with an absence of dogmatism that is very commendable.

In some parts of the work the author is a little more rash. Thus he concludes his account of the slave-making ant, Polyergus, with the dictum "specialization is leading Polyergus to its end!" Whether this is the case must be left to the future to decide. It would have been simpler to say that Polyergus has mandibles unsuited for industrial purposes, and correlatively possesses slave-making habits that do not appear to be very successful.

Of the systematic part of the work we cannot speak so highly; this is chiefly due, it is only fair to say, to inadequate space. There are, as the author says, 10,000 kinds of beetles in North America, as against 1000 kinds of birds. It is small wonder that the attempt to condense an account of 10,000 species and their habits and life-histories into 54 pages does not leave a satisfactory impression. The extensive orders Coleoptera and Diptera have suffered most from their abbreviation. The Coleopterous portion, moreover, has not been adequately revised, the larva of a Longicorn beetle being figured as a type of the larvæ of the Buprestidæ.

Notwithstanding these drawbacks, the work is probably the best that exists for anyone desiring an introductory work on North American insects compressed into a single volume. D. S.

First Steps in Quantitative Analysis. By J. C. Gregory. Pp. vi+136. (London: Edward Arnold, 1905.) Price 2s. 6d.

IN this little book the author has aimed at "providing a grounding in the fundamental principles of quantitative analysis. It includes the use of the fundamental volumetric solutions and several gravimetric estimations." Of the existence of a considerable class of students whose requirements would be satisfied by the scope of the work there can be little doubt, and a small laboratory manual dealing with a few typical gravimetric and volumetric processes cannot be regarded as superfluous. The author's choice of material leaves little to be desired, but exception may be taken to matters of detail. The percentage strength of a solution is defined as the number of grams of substance in one hundred cubic centimetres, a definition which is scarcely acceptable to the majority of chemists. The first alternative method described on p. 64 for the preparation of a normal sodium hydroxide solution may perhaps give results accurate to 1 per cent., but is scarcely consistent with the employment of a multiplying factor containing five significant figures. Such inconsistency in the use of significant figures is not infrequent, and detracts considerably from the value of the book. On p. 67 it is stated that "the specific gravity of strong hydrochloric acid is 1·16 and the liquid contains 31·79 per cent. by weight of hydrogen chloride"—the temperature is apparently of no consequence whatever. A brief consideration of the theoretical side of the methods and operations involved would have made the book considerably more useful as an introduction to quantitative analysis.

H. M. D.

Man: an Introduction to Anthropology. By Dr. W. E. Rotzell. Second edition. Pp. 186. (Philadelphia: J. J. McVey, 1905.)

THE author of this book is a lecturer on botany and zoology in Philadelphia, but the systematic details he adopts are those of "Prof. Alexander Macalister, of the University of Dublin, and of the late Prof. H. Alleyne Nicholson, of the University of Toronto," so no one can accuse him of being up to date in his own subject. "Anthropology," he informs us, "seems to be, unfortunately, one of those subjects about which the vast majority of persons know very little," and with a zeal which far exceeds his knowledge he attempts to remedy this defect; but it is evident his information is second-hand, imperfectly comprehended, and ill-digested.

The following quotations will serve to substantiate this criticism:—"The North Mediterranean branch (of the White or European Race) comprises the Basques, the Aryans, and the Caucasic peoples." "The Indic group (of the Aryans) inhabit an extensive region of Southern Asia. At present there are many different tribes and castes inhabiting the great Indian peninsula, the forms of speech spoken by them presenting numerous diversities"; except for a word or two about Sanskrit and Buddhism, this is all that is given on the ethnology of India. In his final chapter, on the development of culture, Dr. Rotzell puts forward the view that the blazing of trees was the beginning of writing.

Elementary Algebra. By W. G. Borchardt. Pp. vii+492+lxiii. (London: Rivingtons, 1905.) Price 4s. 6d.

THE arrangement of the subject adopted in this work differs from that adopted in many other works, simplicity and ease for the beginner being the chief object. The fundamental operations (addition, subtraction, multiplication) are illustrated graphically on squared paper, and the solution of simple equations is given immediately afterwards, such subjects as fractions, highest common factor, and lowest common multiple being postponed; in fact, fractions are left until the beginner has acquired a considerable skill in the solution of equations. Great use is made of graphic illustration, and by means of it many difficulties are removed from the path of the beginner.

The plan of the book leaves nothing to be desired on the score of simplicity; it is about the most simple work that we have seen. The advanced part of the book may be said to begin with chapter xxxii., which treats of the theory of indeterminate equations. The general theory of quadratics follows, as well as the discussion of progressions, binomial and multinomial theorems, &c. Every branch is illustrated by a large collection of examples, with answers.

Illustriertes Handbuch der Laubholzkunde. Part iv. By C. K. Schneider. Pp. 449–592. (Jena: G. Fischer, 1905.) Price 4 marks.

A PORTION of the Rosaceæ is treated in this part, beginning with Spiræa, passing from the Spiræaceæ to the Rosaceæ and then to Prunus. Why the author distinguishes Spiræaceæ and Drupaceæ as orders is not obvious, but this causes no inconvenience to anyone using the book for practical purposes; and in this connection it should be stated that the analytical tables for running down the genera are made as concise as possible, and that cross references are inserted in the margin to facilitate the comparison of subdivisions.

The part includes three large genera, Spiræa, Rubus, and Rosa; while examining the Spiræas in the Boissier herbarium, Mr. Schneider came across several specimens, chiefly Asiatic, that he regards and has named as new species. In the case of Rubus, a selection has been made of European types and a number of foreign species that may be found suitable for introduction into Europe. Undoubtedly the most interesting portion is that devoted to the roses; the treatment follows very closely the arrangement given by Keller in Ascherson and Graebner's synopsis, but Keller's subsections are classed as sections, a system that is of practical convenience, although it tends to magnify the importance of the subsections. Amongst the changes noted, Schneider follows Keller in superseding *Rosa indica*, L., by *Rosa chinensis*, Jacq., and *Rosa damascena*, Mill, perhaps on account of its antiquity, is numbered as a species.

Esquisse d'une Théorie biologique du Sommeil. By Dr. Ed. Claparède. Extrait des *Archives de Psychologie,* T. iv. Pp. 114. (Genève: H. Kundig, 1905.) Price 3.50 francs.

IN this essay, the contents of which have appeared in certain journals, the author first examines the various theories which have been propounded to explain the occurrence of sleep, and having found these wanting proceeds to formulate a theory of his own.

The various theories of sleep are first classified and discussed, and the difficulties in accepting them stated. All the common theories regard sleep as a cessation of function in the organism, a negative or passive state or phase. The author, however, regards sleep as an active state, a defensive mechanism of the nature of a reflex action, an instinct which has for its object the precipitation of the organism into a condition of inertia whereby exhaustion is prevented. We therefore sleep, not because we are exhausted or asphyxiated or auto-intoxicated, but in order to ward off such effects, and many interesting facts are quoted in support of this hypothesis. The essay deals in a concise and interesting manner with the whole subject of sleep, and is well worthy of perusal.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Percy Sladen Expedition in H.M.S. "Sealark" to the Indian Ocean. The Seychelles Archipelago.[1]

AFTER leaving the *Sealark* and dispatching our collections home, Mr. Forster Cooper and I spent seven weeks in exploring the Seychelles Archipelago as thoroughly as possible, dividing our time between Praslin and Mahé as centres. We camped for eighteen days on the former island, and then separated, Mr. Cooper being responsible for Silhouette Island, the fauna of which appeared to be almost unknown, while I visited various parts of Mahé and examined its reefs and neighbouring islets. Unfortunately the weather had been exceedingly dry, and continued to be so during the first half of our stay, while it was correspondingly wet during the second half. As a result, land collecting was at all times extremely laborious, and insects were throughout found to be scarce, both in species and number. Other groups of land animals we believe to have been fairly thoroughly collected.

The Seychelles Archipelago comprises a number of islands arising on a submarine bank, which extends in a more or less east and west direction, about 190 miles long by 100 miles broad (Fig. 1). It was fairly regular in contour save to the south-east, where a horn stretches out for some distance along the line towards Mauritius. Separated from this same projection by deeper water are three similar but smaller banks, of which that of Coetivy alone has land, and in correspondence there is to the south-west the Amirante Bank with its little group of islands.

The Seychelles Bank itself has an average depth of 30 fathoms, and our soundings off it to the north-west, east, and south show that it has a contour similar to those of typical coral reefs and banks. An outer rim is indicated along the whole of its north-western half by a series of shallower soundings, but to the south-east the depth does not markedly shoal (Fig. 1). It has two typical surface-reefs with coral islets to the north, Bird and Dennis, but elsewhere the rim is generally covered by at least 7 fathoms of water. Between these two islands, and to the west of Bird, the character of the bottom is somewhat similar to what we found at the edges of the submerged Saya de Malha and Nazareth Banks, and indicates the upgrowth of a rim. The fauna was more varied, but the bottom was less covered by nullipores and corals, and a few green algæ were abundant. All sedentary organisms were covered with dirt and unhealthy between Bird and Dennis Islands, where there would appear to be a natural outfall for the tidal and other currents. In this position there is certainly no upgrowth of the rim, while elsewhere it must be exceedingly slow. The bottom within the rim is sand, muddy sand, or mud, the latter held together by the roots of algæ. Strong currents sweep across it, and even during our visit, between the two trades in dead calm weather, the sea-water was always cloudy, so that, except in favoured spots, corals could scarcely grow up into reefs.

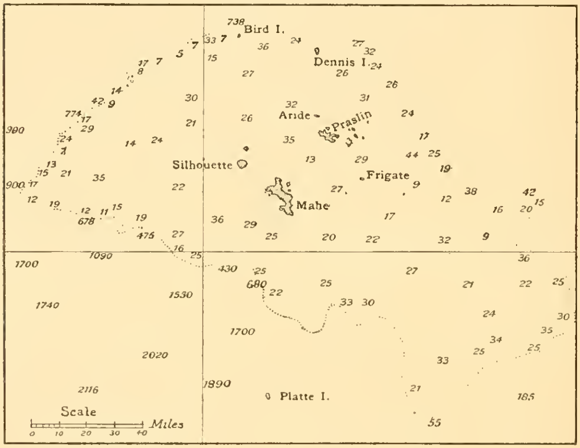


FIG. 1.—Seychelles Bank showing the 100-fathom line.

The islands of the Seychelles naturally divide themselves into two groups to the west and east, with Mahé and Praslin as centres (Fig. 2). The former comprises Mahé, Silhouette, and North, with a series of small islets around the first, outlying buttresses and peaks of the same, with only a few fathoms of water between. Praslin also is similarly surrounded by a series of tiny islets and rocks, but in addition there are eleven other islands in its group (of which we visited five), separated by considerable channels. Mahé and Silhouette attain heights respectively of 2993 feet and 2467 feet, but Praslin and the eastern islands do not exceed 1270 feet. All islands were found to be formed of similar, coarse granites (or granulitic quartzes), with narrow, vertically extending dykes of finer grained black rock, apparently a variety of granite, along which the mountain streams have invariably cut their courses. In addition, many of the islands have against their coasts, in bays and suitable situations, flats of sand, largely coraliferous. Some of these have doubtless been formed by a washing up of sand from the sea, and some are partially at least of delta formation, but in places there is evidence of a recent elevation of more than 30 feet. On the island of Silhouette, Mr. Cooper in five situations found masses of coral rock, cemented on to the granite, at various heights between 15 feet and 30 feet above the low-tide level, and around the coasts of Mahé and its smaller islets there is evidence of a similar upheaval. Besides this, there are indications (particularly in Mahé) of an ancient elevation of upwards of 200 feet. Definite rocks belonging to it do not, so far as I could find, still exist. Marine action prior to its occurrence perhaps accounts for the almost continuous line of precipices, which at various distances from the present coast extends along the eastern or windward side of Mahé. The question, however, requires further investigation. In any case, the deep cañons of many of the mountain brooks, and the very extensive weathering of the granites, indicate the not inconsiderable antiquity of the land as such.

Barrier reefs nowhere exist around the islands of the Seychelles Group, and fringing reefs only in certain somewhat protected situations (Fig. 3). Mahé Island extends more or less north and south, with two conspicuous points to the west. A fairly continuous reef lies along its east side, but there is no reef off its north and south points, and reefs only occur in the bays of its western side. Silhouette is a round island with practically no reef, while Praslin has reefs in its bays alone. La Digne, Curieuse, and the smaller islands have merely patches of reef. On examining into the causes of this we found a luxuriance of coral growth even off the points of the islands, but practically a complete absence of nullipores. Indeed, these calcareous algæ are essential in the Indian Ocean for the consolidation of corals into true reefs. Where fringing flats actually do occur, they would appear generally to consist of a basis

[1] For earlier reports see NATURE, April 13, August 10, October 5, November 9, and December 21, 1905.

of granitic rock with quite a sparse covering of calcareous matter, or to be a filling in with the remains of some of the reef organisms between masses or islets of granite and the land. The reef in the large bay to the north of

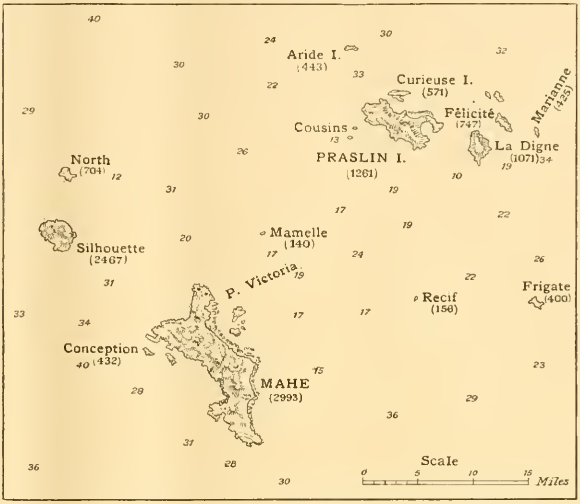


Fig. 2.—Islands of the Seychelles Group with heights in feet and soundings in fathoms.

Praslin, extending along the coast for $1\frac{1}{2}$ miles between two points, is a good instance of this, one islet and three series of granite masses lying at almost equal intervals imbedded in its seaward edge. The boat passages through the reefs are in most situations mere outfalls for the tide, and show no connection with the fresh-water streams off the land. Finally, it is interesting to note that the actual surfaces of the flats are covered with a far greater variety of large seaweeds than we found in any of the purely coral groups we visited in the *Sealark*.

The land animals necessarily to a large extent depend on the plants, and I considered it inadvisable to attempt their complete collection in the limited time at our disposal save in the indigenous jungle. Small mangrove swamps occur on the sea-shore, but behind these the land has been almost completely cleared for the cultivation of cotton, coffee, cassava, cocoa, and vanilla to a height of 1500 feet. Below this there are only a few isolated endemic trees, and above there are in patches in the jungles large numbers of oranges, limes, citrons, and cinnamons, with an undergrowth of the Mauritius raspberry, all introduced plants. Indeed, there are, except in Silhouette, only a few summits and precipitous slopes which have not been at one time or another completely planted, and it seems possible that even these may be destroyed within a few years for the cultivation of various rubbers. Such jungles as now remain consist mainly of palms (Roscheria, Stevensonia, Nephrosperma, Verschaffeltia), various screw pines (Pandanus), Dracæna, and the bois rouge (Wormia), with bare ground beneath covered by their strong leaves, clumps only of Curculigo. Open spots, however, have a dense undergrowth of ferns, Lycopodia, Selaginellæ, Psilota, and mosses, which also cover the lower parts of the trees. In effect, it is a typical, tropical, moist forest undergrowth, noticeable mainly for the comparative absence of climbing plants and herbaceous dicotyledons, and for the fact that nearly all the larger trees are peculiar Seychelles species, and often genera. Most of the giant trees (Maba, Stadtmannia, Afzelia, Campnosperma, &c.), have been singled out and cut, but bare stems of capucin (*Northea seychellarum*) stand up everywhere above the foliage. The destruction of the latter, which probably will shortly be complete, we discovered to be due to a green beetle, which deposits its eggs singly in the new leaf-buds, the resulting maggot consuming all their softer parts.

The most interesting feature in the botany was the sharp distinction of the cotyledonous plants into three classes, the calciphilous, the siliciphilous, and the indifferents, the latter forming a smaller percentage of the whole than either of the other two. The calciphilous species are practically the same as we found on all the coral islands we visited, and are scarcely more numerous. This group of plants was, I consider, ocean-carried, the Seychelles being in respect to it as oceanic as any island of the Chagos Archipelago. Moreover, of the other trees many seemed to possess seeds, which could have been brought by currents, &c., to the islands. The finest individual species of tree was the coco-de-mer, or double coconut (*Lodoicea seychellarum*), which is peculiar to

FIG. 3.—Fringing Reef with boat passage to the south-east of Mahé Island, looking south

Praslin. Its palms are either male or female, and our examination of more than 300 of its nuts showed that they are of two distinct, structurally different forms in approximately equal proportions, both kinds growing on the same female tree. The case is, so far as I know, unique.

Of the land animals we did not attempt to collect the birds, as they were already sufficiently known. Moreover, most of the peculiar Seychelles species would seem to have been nearly, if not entirely, destroyed by paid collectors. The Government of the Seychelles has, however, promised an ordinance to hinder further destruction. The introduced birds do not belong to the jungle, where, indeed, land birds are seldom seen. Mammals are represented by rats, mice, and bats, and the tenrec runs wild everywhere. Of reptiles we obtained about eleven species of lizards and three snakes. The crocodile would once seem to have been a regular inhabitant, but the last was killed about seventy years ago. Three of the apparently four species of frogs occur at any elevation, but the fourth is peculiar to the high jungles. Cœcilians are numerous, the one genus being an earth burrower, and the other lying under damp leaves in the jungles. Mollusca were represented among the indigenous vegetation by twenty-five to thirty species, including two slugs, and we obtained a fair variety of insects and arachnids. Isopods were numerous everywhere, but centipedes and millipedes were scarce on the high lands, and seemed to consist of species peculiar to them. We carefully searched for Peripatus, but do not think it exists in the archipelago. Land worms were scarce; one species was peculiar in living within the bases of the screw pine leaves, even 40 feet to 50 feet above the ground. We obtained no land leeches or Turbellarians, but found two species of Nemerteans at about 2000 feet.

The fresh-waters consist of certain pools near the sea and a large number of tiny mountain streams, which become roaring torrents in the wet season, but never dry up. In a pool at La Digne we obtained one tortoise with hinged plastron, and in the streams there were four species of fish. The Crustacea comprise at least two species of prawn and a crab, all living up to more than 2000 feet. The Mollusca number only three, and for the rest there were the usual genera of fresh-water insects, &c.

The number of species of land and fresh-water animals would on the whole appear to be singularly few, and individuals were, with a few exceptions, by no means abundant. Their small variety may be due to the comparatively few plants which grow in the islands, but one is inclined to question the former connection of the group with any larger land mass. In any case, our work has made certain that the archipelago has been sufficiently collected for a thorough examination into this question from a biological point of view. It is our opinion, however, that such a research should include both animals and plants considered together. In any case, the Seychelles is the continuation of a broken line extending north from Madagascar, and its rock would seem to be similar to that which forms the great central plateau of that island.

Since I returned to England I have received a letter from Commander Boyle Somerville giving the soundings obtained by H.M.S. *Sealark* on her return to Ceylon from the Seychelles. He has confirmed by additional soundings the complete separation of the 2000-fathom lines of the Chagos, Maldive, and Seychelles groups. I have also heard from Mr. D. Matthews that he has obtained about 1000 samples of sea-water from the Indian Ocean during the last nine months, and analysed about 700. Mr. Bainbrigge Fletcher, H.M.S. *Sealark*, reports that a considerable number of the Chagos Lepidoptera appear to be new species or varieties.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge, January 15.

What Causes the Destructive Effects of Lightning?

I ENCLOSE a cutting from the *Hampstead and Highgate Express* (January 20) containing an epitome of a lecture which I lately gave at the local scientific society on a case of death by lightning which occurred on the Heath in the month of July last.

I discussed, amongst other matters, the question as to how the more destructive effects of lightning were produced, and now my object in writing to NATURE is to ask you, Sir, or any of your readers, if you can inform me whether this question has been solved in any probable manner. In the case of the death of an animal from lightning I think we may safely rest on the word electricity as sufficient, for it is not difficult to understand how this form of energy when let loose in the organism of an animal should not only disturb the equilibrium of the machinery, but actually stop it. But the word electricity does not seem sufficient to account for the more destructive effects produced by lightning, which closely resemble those which arise from other well known allied forces. Heat certainly is produced, as we see by the burning of the flesh and by its effects on metals, but as regards the destruction of trees, buildings, and other imperfect conducting substances, the forces seem to be of an explosive character, as are mentioned in the accompanying extract from my lecture.

"The subject which was of most interest to the lecturer was the nature of the destructive agency of the lightning flash, and the present fatal case he thought threw a considerable light upon it. Of course, there was no difficulty in understanding how an electric shock can kill an animal suddenly by bringing the machinery to a stop, when it is considered how fearfully and wonderfully we are made, and that vital processes are at work in every part, when a violent electric shock comes and arrests all these at once. But it is not so easy to perceive how all the more marked and mechanically destructive processes occur, such as the splitting of the timbers in the hut or tearing off the clothes. The destructive effect seemed to be exactly of the kind which follows explosions of gunpowder and kindred substances. This could only occur through a gas being suddenly formed; but whether this would be the production of the vaporisation of a liquid or the formation of some new conditions of the atmosphere by the electricity itself cannot at present be determined. The first object struck by the lightning was the finial, and this was split into numbers of pieces in the direction of the grain of the wood, and the same effect was seen on all the upright posts down which the lightning ran; but, midway across the middle of the hut was a transverse beam, through which the flash passed. At this spot about a foot of the wood was torn off, but in a transverse or horizontal direction in the course of the grain. If a chisel had been driven into the cross beam it would have broken the wood exactly in the same manner; or, indeed, any other force acting on the middle of the splintered wood as an explosive. The coat, and more especially the shirt, showed the explosive force which had produced the rents still better. Although the rents ran down the arm, they had no appearance as if done by an instrument, but rather by a violent pull exerted from side to side, for not only was there one large rent, but similar partial ones running parallel to it. These could only have been done by forcibly stretching from within; in fact, the only way suggested would be an explosion of gas taking place in the shirt sleeve, and so forcibly thrusting it out, causing the fibres of the fabric to give way. The split boot, which was nearly off the foot of the child, could not be imitated except by placing a charge of dynamite within it."

Not professing to have much knowledge of what has been written on the modes and causes of the great destruction caused by lightning, I am writing to obtain more information on the subject. SAMUEL WILKS.

January 20.

The Probable Volcanic Origin of Nebulous Matter.

IN papers published some fifteen years ago (see, among others, Nos. 2 and 4 of *Contributions from the Lick Observatory*) I considered certain phenomena produced by streams of finely divided matter ejected from the sun, each stream necessarily taking on the form of a helix, and stated that the nebulosities surrounding certain stars were probably caused by the presence of streams similar to those which produce the solar corona.

In an effort to explain the fact that in certain spiral nebulas two diametrically opposite streams are, as a rule, most conspicuous, Prof. Chamberlin advanced the theory (see *Astrophysical Journal* for 1901, p. 17) that the disruption of one body through tidal action and centrifugal

force caused by the near passage of another body moving with great velocity would account for the observed phenomena. I am of the opinion that no forces except those originally resident in the central body itself are essential for the creation of such structures.

As a supplement to my note in NATURE for January 14, 1904, I now wish to offer a very simple theoretical explanation of the manner in which the ejective force becomes so very powerful.

As a result of the decrease in temperature from the centre to the surface of an incandescent mass exposed to the cold of space, the surface-crust finally formed will be punctured at various points by the imprisoned gases, thus also allowing the more refractory matter from the interior to overflow the region immediately surrounding each vent; the increased weight of the locally thickened crust causes the lower opening (of the channel formed) to be depressed below the general level; as the height of the surface-cone increases the simultaneously formed inverted cone is forced deeper and deeper into the regions of greater temperature and pressure, where matter exists in the form of compressed gases. The more easily volatilised materials of the depressed mass will be dissipated, leaving only the more refractory elements to form the inverted cone.

So long as there is a free flow of gaseous matter, the higher the volcanic cone the greater will be the ejective force, and, owing to internal reactions, diametrically opposite vents will be most powerful. We therefore reach, as it seems to me, the theoretical conclusion that *in the act of cooling, an originally incandescent body has the power to create conditions which will enable it to remove a part of its mass, in a finely divided state, to distances which may be far beyond the sphere of its own sensible attraction.*

J. M. SCHAEBERLE.

Ann Arbor, January 8.

On an Alleged New Monkey from the Cameroons.

IN NATURE for October 26, 1905, Dr. H. O. Forbes described, as representing a new species, a monkey (Guenon) from the Cameroons, which he named *Cercopithecus crossi* in compliment to Mr. Cross, of Liverpool, to whom it belonged. The description tallied so closely with that of *C. preussi*, based by Matschie in 1898 upon specimens also from the Cameroons, that I strongly suspected the two species would prove to be identical. That this is the case I have now no hesitation in affirming after examining the type of *C. crossi*, which Mr. Cross has sent to the Zoological Gardens in London.

R. I. POCOCK.

Zoological Society's Gardens, January 17.

Sounding Stones.

IT may be of interest to add to the list of musical stones provided by your correspondents another limestone, viz. the very hard, crystallised, coral rock of the coasts of British East Africa. Among the bizarre forms assumed by these rocks under the erosion of the sea, isolated pillars with projecting arm at the top, like a gallows or an inverted capital "L," are common in places. This horizontal arm in many cases gives a clear musical note when struck with a stone or hammer, being thus a ready suspended natural gong.

CYRIL CROSSLAND.

Broughton in Furness, January 18.

Chinese Names of Colours.

IN NATURE of January 11 (p. 246) Mr. A. H. Crook refers to some colour terms used by Chinese. *Ts'eng* (Cantonese) or *ch'ing* (Pekingese) is a vague Chinese term applied to black, grey, "neutral tint," ocean green, sky colour, blue, &c., but nearly always with a gloss or sheen upon it. The fresh turnip-like pears of China are called in Canton *süt*$_{\circ}$ *li*, or "snow-pears" (the small circle following the *t* indicating the "tone" of the word). Williams's Dictionary of 1878 gives *hsüeh-ch'ing* (Pekingese) or *süt*$_{\circ}$*-ts'eng* (Cantonese) as "a purple colour," and the allusion is evidently to that bluish glassy tinge that frozen snow takes, as seen in glaciers, icebergs, and so on; in short, all "vitreous" or glassy hues, from beer-bottles to mother-of-pearl, are *ts'eng*.

E. H. PARKER.

THE WORK OF THE NATIONAL ANTARCTIC EXPEDITION.[1]

CAPTAIN SCOTT is warmly to be congratulated on the two interesting volumes in which he describes the work of the National Antarctic Expedition and gives his conclusions as to its results. The book, naturally dedicated to Sir Clements Markham, is a most valuable contribution to the knowledge of what will probably always be one of the most interesting parts of the Antarctic continent. It is written in a charmingly easy and fluent style; the narrative is modest and frank; and the story is always pleasant reading, from its evidence of the uniform good temper which prevailed throughout the expedition, of Captain Scott's capacity for handling his men, of his sympathetic appreciation of their high endeavour, and of his keen interest in all branches of the work. The book is illustrated by a series of fine photographs, many of which were taken by Lieut. Skelton, and its value is greatly increased by the beautiful sketches of Dr. Wilson.

The story of the expedition is full of incident and adventure in most of which Captain Scott had a large share, as he exposed himself to its greatest risks. The two main achievements of the expedition are Captain Scott's fine sledge journeys with Dr. Wilson and Lieut. Shackleton to the farthest south, and with Evans and Lashly to the farthest west that was reached in Victoria Land. Both these undertakings were daring and arduous in the extreme. The sledge journey to the south reached the latitude of 82° 16′ 33″ from 77° 51′, and this spirited performance would probably have been even more successful but for the death of the dogs. The journey westward on to the plateau of Victoria Land Captain Scott describes as even more severe than that to the south, and regarding it he says:—"I cannot but believe we came near the limit of possible performance."

The scientific results of the expedition cannot yet be fully stated, as the collections and observations have not been worked out; and we shall have to wait in most cases for the reports of the experts to whom the material has been entrusted. Captain Scott's book contains accounts of the chief work in geography, in vertebrate zoology, and in geology. The Antarctic mammals and birds are described in an interesting chapter by Dr. Wilson, in which the most important contribution is the account of the life-history of the emperor penguin, which was studied on its breeding-grounds by himself and Lieut. Skelton. The volumes contain no technical information about the invertebrates, &c., and it is disappointing to learn that we cannot expect any additions to the deep-sea fauna of the Southern Ocean. The wealth of new material collected by the *Challenger* in its one deep haul in the Antarctic, led to hopes that valuable results would be achieved by the powerful deep-sea equipment of the *Discovery*; but apparently it was very little used, owing to the short time spent at sea, and possibly on account of the limited coal supply. One dredging is referred to at the depth of 610 fathoms, another at 100 fathoms, and a third, also in shallow water, off the great ice-barrier. The invertebrate fauna, of which Mr. Hodgson has already described elsewhere some of the more interesting discoveries, seems to have been chiefly collected under the ice in McMurdo Sound by means of his very ingenious devices.

The principal geological results are stated in a

[1] "The Voyage of the *Discovery*." By Captain R. F. Scott, C.V.O. Vol. i. Pp. xx+556. Vol. ii. Pp. xii+508; with two maps and 272 illustrations. (London: Smith, Elder and Co., 1905.) Price 42*s*. net.

valuable appendix by Mr. Ferrar, which is to be followed, in the volumes on the scientific work of the expedition, by a more detailed account of the rocks, and we may hope also by more precise information about the ice. Captain Scott describes the admirable pains devoted to the observations in physics and meteorology, the results of which are being worked out.

The geographical work—"surveyed under the direction of the R.G.S.," the chart informs us—is stated and discussed at length. The chief geographical results were achieved by the sledging parties. The results thoroughly justify those who advocated the selection of McMurdo Sound, or Bay as it was then called, as the winter quarters, owing to its high latitude, its exceptionally interesting geographical position, and its easy accessibility "great icy barrier," owing to the mystery suggested by its name, and perhaps, in part, to what, according to Captain Scott, was Ross's exaggeration of its height and uniformity. Ross's conclusion that this ice-sheet is afloat along its seaward face has been fully confirmed; and the important discovery has been added, by observations on a food depôt, that the ice is moving in one place at a rate estimated at 608 yards in $13\frac{1}{2}$ months. Captain Scott regards this ice-sheet, a smaller sheet in Lady Newnes Bay, and a mass ashore at Cape Crozier, as relics of a vast sheet of glacier ice, which once filled the whole of the Ross Sea, and floated when the reduction in its thickness rendered it buoyant.

The geographical problem of most importance is the form and area of the Antarctic continent. It is gratifying to those who believe in the value of geo-

FIG. 1.—Highest Ice-wall (280 feet) on the Ice-Barrier, showing the regular stratification. From "The Voyage of the *Discovery*."

in the summer. There is one quaint mistake in the book in reference to the main hut erected there, which is described (p. 215) as of a design used by "outlying settlers in that country" (Australia); whereas the design was based on Peary's Greenland hut, and the modifications, suggested by Australian experience, were devices used there to render the walls of the frozen meat warehouses impermeable to heat and cold.

The headquarters were established near Mount Erebus, which is still in quiet activity, and (disregarding the feelings of those who like scientific precision in geographical terms) the volcano is described throughout the book as giving forth smoke, fire, and flame.

The widest popular interest is perhaps felt in the graphical homologies, to find how fully the suggestions based on them have been justified by the work of the Antarctic expeditions. The important discovery of Coats Land by the Scotch expedition has revealed the southern shore of the Weddell Sea even further north than the position assigned to it in Sir John Murray's sketch-map. The German expedition has re-established faith in the continuity of the land, in an area where the soundings of the *Challenger* had thrown doubt on it, and where it was possible that there might be a deep southern indentation opposite the basin of the Indian Ocean.

The only serious alteration suggested in the outline of Murray's Antarctica is that the Pacific coast between Graham's Land and Victoria Land may possibly be further south than was expected. The

projection eastward of Ross Island and the peaks called by Ross the Parry Mountains, which were all regarded as part of the mainland, suggested that behind Ross's ice-sheet the mountains of Victoria Land trend to the east. Captain Scott tells us that the Parry Mountains do not exist; but a group of islands, White Island, Black Island, and Minna Bluff, occur in almost the same relation to Mounts Erebus and Terror as Ross marked his Parry Mountains. Behind this archipelago there is a great bight, the land first trending somewhat westward, and bending to the east after about 81° S. Thence, so far as Captain Scott could see, the land has an average trend to S.S.E. from Mount Wharton to the most distant southern peak observed beyond Mount Longstaff. Captain Scott concludes that the mountains continue in the same direction to Graham's Land. There is nothing *a priori* improbable in the connection of Victoria Land and Graham's Land along this line; for coasts of the Pacific type are characteristically straight for long distances, and have broad open curves rather than sudden bends.

This does not affect the essential part of my suggestion made in Nature, April 25, 1901, "that we may expect the greatest elevations on the Antarctic Lands will lie along the Graham's Land-Victoria Land line, and will be near the sea. To the south of the main mountain range there may be an undulating ice-covered region descending slowly across the Pole to the shore of the Weddell Sea. The main ice drainage would then be not from the Pole radially in all directions; the ice-shed would run along the Pacific Shore with a short steep northern face and a long gradual slope southward to the Pole and across it northward to the Atlantic." This view is fully supported by Captain Scott's opinion that, according to his view of the course of the main mountain chain, "the geographical pole would be situated 200 miles more from it, and on the high ice-plateau which must continue behind" (vol. ii. p. 427).

The lands, problematical and proved, to the south of the Pacific probably belong to one of those island festoons, which are still so characteristic, and apparently once occurred along all the Pacific coasts. The only objection to placing the main coastline of the South Pacific south-west of Ross's ice-sheet, instead of along a line north-eastward through King Edward Land, is the ice-barrier, on Captain Scott's theory of its formation. If it be land ice, and be flowing rapidly northward, a mile in three years, it must be fed from snow-fields among mountains to the south, and is probably confined between high lands to east and west.

Fig. 2.—A camp on the "Ross's Ice-Sheet," showing the snowy texture of the surface. From "The Voyage of the *Discovery*."

It is here that we feel most the need of more precise information regarding the ice of Ross's ice-sheet, as Ferrar proposes it should be re-named. That this ice is land ice flowing out to sea has been the generally accepted explanation of the facts described by Ross. The difficulty presented by Ross's ice-sheet, if it be advancing northward along its whole face at anything like the rate of the ice movement round Minna Bluff, is that its surface appears to be practically level, so far as it was followed by Royds to the south-east and by Scott to the south. Hence its rapid movement cannot be due to flow down a slope as in the case of ordinary glacier ice. The best

photograph of the ice (vol. i., p. 192) shows that it is very regularly stratified, and there is no visible interglacial material; the ice appears very different from that typical of glaciers. A photograph of a block of the barrier ice, of which the structure had been brought out by throwing over it a bucket or two of hot water, would have been very useful. The characters of glacier ice are so distinctive that any precise information as to the structure of the barrier ice would have left no doubt as to its nature. The photograph (Fig. 1) which gives most information about the ice suggests that, at least the part above sea-level (see also Fig. 2) has been formed by the accumulation of layers of snow upon the surface, more quickly than the ice was dissolved by the sea beneath. If this view of the origin of the ice sheet be correct, both its horizontal position and the gentle undulations of its surface are intelligible; and it forms no obstacle to belief in the connection of Graham's Land and Victoria Land along the shortest and most direct line. In this case Ross's ice-sheet will agree in character with the floebergs of Sir George Nares's Palæocrystic Sea, except that they were supposed to have grown by the additions of layers of ice from the sea below, instead of by the fall of snow from above. In this connection, some information as to the rate of solution and growth of the ice in sea-water at various temperatures would have been useful. Captain Scott tells us that such observations were suggested in the "Antarctic Manual." I have been unable to find there the passage referred to. The suggestion is, however, dismissed (vol. i., p. 305) as ridiculous. More than once during the course of the expedition the observations desired were accidentally noticed, but the conditions are not stated with sufficient precision to be of service.

The structure of Victoria Land, both geographically and geologically, is much as was expected from the considerations which led to the conclusion, first suggested by Ritter, that the eastern coast of Victoria Land represents the continuation of the volcanic line of New Zealand, and that a plateau occurs behind it. The discovery of the plateau structure seems to have occasioned surprise, though the hope was expressed in NATURE, April 25, 1901, p. 612, that one party would "cross the volcanic mountain chain to the plateau that probably lies beyond it." The geological structure, as described in Mr. Ferrar's interesting chapter, consists of low-lying archæan coast hills, beyond which occur sheets of horizontal sediments and broad sheets of plateau basalts. Huge volcanic cones occur off the main coast line, like the worn down volcanic hills of Dunedin and Bank's Peninsula in New Zealand, and apparently there are great volcanic cones on the plateau near its edge. It would be difficult to find land with a structure more typical of the Pacific coast type.

In contrast to the extensive discoveries achieved by the sledging parties from the winter quarters are the limited results obtained at sea, which make the title of the book, "The Voyage of the *Discovery*," somewhat of a misnomer. In the book 176 pages are devoted to describing the whole voyage of the *Discovery* from London to London, and 698 pages to describing the sledging and other work on shore. It was hoped that the *Discovery* would have thrown some light on the two chief problems offered by the outline of Antarctica, in the area reserved for the British sphere of operations. After the discovery of Coats Land by the Scottish expedition, the longest unknown stretch of the Antarctic coast is that south of the Pacific. It was believed from the work of Ross and Cook that land exists connecting Graham's Land to that on the eastern edge of the barrier. The *Discovery* has confirmed the existence of land close by the point where Ross described his "strong appearance of land"; but the necessity for the whole expedition returning to winter on McMurdo Sound prevented the discovery of its nature. Captain Scott seems disposed to regard this land as probably volcanic, and Mr. Ferrar as probably continental.

It was also hoped that the expedition would determine the character of the land to the west of Cape Adare; for a section along that coast, which cuts across the grain of the continent, would no doubt give more information as to its structure, than could be obtained along the coast of Victoria Land or by a traverse of the ice-clad interior. But here again the expedition had to return from the threshold of the unknown regions. This was Captain Scott's misfortune, and was in no way his fault. It was the result of the plan of the expedition being to keep the *Discovery* at the winter quarters. The limited work done by the *Discovery* at sea, and its inability to accomplish the much desired deep-sea trawling, is possibly due to the heavy demands on the available coal supply made by her engines; for the 500 horse-power which they gave required a large consumption of fuel, and this rendered impossible any prolonged period of full steaming away from a coaling station. Whether the *Discovery* was a complete success as a ship appears doubtful. Captain Scott praises many features in its design, and of its magnificent strength there can be no question. But in spite (vol. ii. p. 327) of what Captain Scott calls the "depth of sentiment" he naturally feels for the ship, "which for long proved such a comfortable home," he says that when they tested her sailing qualities they "found to our chagrin that they were exceedingly poor"; she had a fine capacity for rolling, sometimes going over 90°, and he describes (vol. ii. p. 375) her "lurching from side to side in the most uncomfortable fashion while our consort [the *Terra Nova*] followed in our wake with scarcely a movement." Her leakiness is described as a continual source of trouble, and the only expression of irritation in the book is at "another very stupid arrangement" in the ship (vol. i. p. 339). But for the somewhat meagre results achieved by the *Discovery* Captain Scott is not responsible; if the ship could have been kept at work at sea, while Captain Scott was doing his sledge journeys on land, a wider and richer harvest of results would doubtless have been obtained.

J. W. GREGORY.

RECENT ETHNOLOGICAL PUBLICATIONS FROM THE FIELD COLUMBIAN MUSEUM.[1]

OF peculiar interest is Dr. Dorsey's account of the ceremonial organisation of the Cheyenne, which dates back, according to tradition, to two or three thousand years ago, being founded by Motzeyeuff, a prophet who came as a messenger from the Great Medicine with four great medicine arrows, which were sent to the Cheyenne as an emblem for their future, as they possessed magic, and the Great Medicine decreed they should produce effects beyond natural powers. These arrows are still preserved, but two of them are in the hands of the Pawnee. The prophet organised five societies—the Red Shield, Hoof-rattle, Coyote, Dog-men, and Inverted Bow-string. The first two of these are concerned with

[1] Voth, H. R.: "Oraibi Natal Customs and Ceremonies." Field Columbian Museum, Chicago 1905. *Anthropological Series*, vol. vi., No. 2. "Hopi Proper Names," *ibid.* vol. vi., No. 2. "The Traditions of the Hopi," *ibid.* vol. viii.

Dorsey, G. A.: "The Cheyenne: I. Ceremonial Organisation," *ibid.*, vol. ix., No. 1. "The Cheyenne: II. The Sun-Dance," *ibid.*, vol. ix. No.

the capture respectively of the bison (buffalo), elk, and deer. The Coyote society derives its name from the fact that its members imitate the coyote in their power of endurance, cunning, and activity; they outstrip their fellow-tribesmen in running long distances, playing games, &c. The Dog-men were raiders. It would therefore seem evident that, judging from the analogies in Australia and Torres Straits, these are

FIG 1.—Self-inflicted torture by a Cheyenne, for performance of the sun-dance. The thongs are attached to the centre-pole. From a painting by a native artist.

in reality ancient totemic clans which were re-organised by the prophet and still retain their magical functions. The Inverted or Bow-string Warrior society is but little known throughout the tribe; it was founded by the prophet subsequently to the others; there was no chief, each warrior being independent of the rest, though all dressed alike and were always prepared for war. The close observance of the regulations of this society by its members gives them a character distinct from that of the other societies, and they are regarded as pure. They rejoice in the beauty of nature as the work of the Great Medicine, who created the rivers, hills, mountains, heavenly bodies, and the clouds. They are the philosophers among the people. Since the advent of the white man a sixth warrior society, the Owl-man's Bow-string or Wolf Warriors, has been founded; it alone, of all the warrior societies, dances with guns, and they shoot blank cartridges. This paper is illustrated by a number of plates, most of which are facsimiles of coloured drawings by Cheyenne artists; they illustrate the ceremonial costumes and paraphernalia of the members of the societies, as well as sun-dance myths; the drawings are so much in advance of those usually drawn by backward peoples as to suggest that the artists learnt from Europeans. It would have been an advantage if Dr. Dorsey had said a little more about the conditions under which they were executed; the idea of illustrating a memoir by native talent is a good one.

The Cheyenne sun-dance is described in considerable detail in a separate memoir, and is copiously illustrated with 105 figures, nearly all of which are from photographs, and some fifty plates, many of which are in colours. In 1903 Dr. Dorsey published an elaborate monograph on the Arapaho sun-dance (*cf.* NATURE, June 28, 1904), and now we have from his pen a companion account of the same dance as performed by another tribe of Plains Indians. The name given by the Cheyenne to the sun-dance is the New-Life-Lodge; according to the interpretation of the priest, the name means not only the lodge of new life, or lodge of new birth, but it is the new life itself. The performance of the ceremony is supposed to re-create, to re-form, to re-animate the earth, vegetation, and animal life; thus it is the ceremony of the re-birth. As one of the priests put it, "Formerly this dance represented only the creation of the earth. The Cheyenne grew careless and combined other things with the ceremony. At the time of the Love-tipi (or Sacred Lodge), though everything is barren (referring to the bare space made within the tipi), the earth is beginning to grow. Now it has grown. Thus they make the earth, buffalo wallow, grease, wool, and sinew to make growth. By the time of the end of the lodge things have grown, people have become happy; the world has reached its full growth, and people rejoice. When they use the bone whistle they are happy like the eagle, which is typical of all birds and of happiness."

It would take too long to describe the ceremonies, which are evidently very ancient and sacred. Thanks to the labours of Dr. Dorsey and other American colleagues, the religious symbolism of the Plains Indians is beginning to be understood, and researches such as these will afford valuable data to the students of comparative religion. The rite of sacrifice by means of self-inflicted torture was common to many of the Plains tribes, but, so far as is known, it was

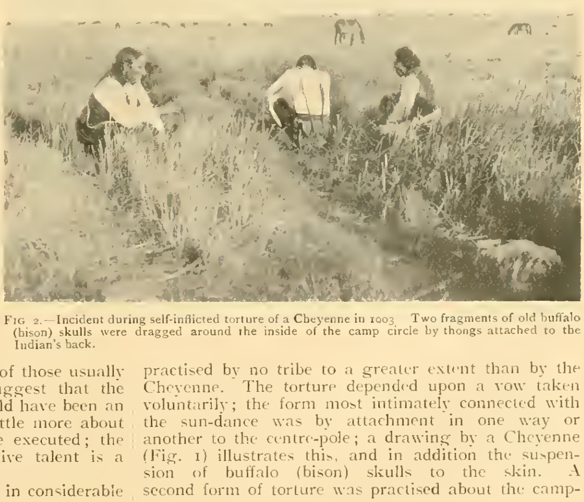


FIG 2.—Incident during self-inflicted torture of a Cheyenne in 1903 Two fragments of old buffalo (bison) skulls were dragged around the inside of the camp circle by thongs attached to the Indian's back.

practised by no tribe to a greater extent than by the Cheyenne. The torture depended upon a vow taken voluntarily; the form most intimately connected with the sun-dance was by attachment in one way or another to the centre-pole; a drawing by a Cheyenne (Fig. 1) illustrates this, and in addition the suspension of buffalo (bison) skulls to the skin. A second form of torture was practised about the camp-

circle rather than within the sun-dance lodge. Of this form the commonest method was for the dancer to drag one or more dried buffalo skulls attached to skewers inserted in his back, just as the skewers were inserted in the breast in the previous form of torture (Fig. 2).

Mr. H. R. Voth continues his valuable investigations on the Hopi Indians with a particularly interesting account of the customs and ceremonies connected with birth in Oraibi, the largest of the seven Hopi villages, and a suggestive paper on Hopi proper names. When a child is twenty days old it receives its first names from the grandmother, or other close relative on its mother's side, and from other women, all of whom must belong to the clan of the mother and child. The "child-name" is retained until the child is initiated into some order or society, when a new name is given, and at every subsequent initiation a fresh name is given. All Hopi proper names have some reference to the clan totem of the name giver, never, unless coincidentally, to the clan totem of the bearer of the name. The same investigator publishes 110 traditions of the Hopi, which were collected in the vernacular and without an interpreter.

A. C. H.

NOTES.

SIR WILLIAM THISELTON-DYER, K.C.M.G., F.R.S., has been elected a member of the American Philosophical Society.

BARON DE GUERNE has been elected president for 1906 of the Paris Geographical Society, M. E. H. Martel chief vice-president, and Baron Hulot general secretary.

THE editors of the *Geological Magazine* have issued invitations to a reception to be held on the evening of February 8, to commemorate the publication of the five hundredth number of that periodical.

PROF. KARL VON FRITSCH, president of the Leopold-Caroline Academy, and professor of geology and palæontology in the University of Halle, died on January 9 in his sixty-seventh year. Of his written works, the most widely known is his "Allgemeine Geologie."

FROM Basel we learn that Swiss engineers have sketched out a plan for connecting Switzerland with the North Sea and the Mediterranean by means of an immense canal system at an estimated cost of 324,000,000 francs. On the one side Rotterdam is to be reached from Lake Constance by means of the Rhine, and on the other side Lake Como is to be brought into connection with the Mediterranean by means of the River Po.

THE sum of nearly 2000*l.* has been given by Judge Holek (Denmark) for the purpose of effecting Porsild's plan of a biological station in Greenland, and the Danish Government has agreed to be responsible for a large part of the annual upkeep of the station, which is estimated to run to 11,000 kroner (111*l.*). The most eminent travellers in polar regions in general, and in Greenland in particular, have testified to the value of such a station.

ON Thursday next, February 1, Mr. Benjamin Kidd will begin a course of two lectures at the Royal Institution on "The Significance of the Future in the Theory of Evolution," and on Saturday, February 3, Mr. J. W. Gordon will deliver the first of two lectures on "Advances in Microscopy." The Friday evening discourse on February 2 will be delivered by Prof. S. P. Thompson on "The Electric Production of Nitrates from the Atmosphere," and on February 9 by Mr. H. F. Newall on "Eclipse Problems and Observations."

A NOTE special to Monday's *Pall Mall Gazette* announces that "a new system of wireless electrical communication that seems admirably suited for connection over distances of a few miles, and that possesses the advantage of cheapness, reliability, and secrecy in a degree that probably exceeds all the other systems, has just emerged from some very successful trials in Germany." The experiments described were made near Berlin by Mr. E. Ruhmer, but the "special" news referring to them adds nothing to the account of his system given in NATURE two years ago (February 18, 1904, vol. lxix., p. 373) in an article on "Photo-telephony."

MR. ELNAR MIKKELSEN, the young Danish explorer who, in conjunction with Mr. Leffingwell, an American, is organising an expedition to the Beaufort Sea, has just left this country for the United States. It is proposed that Mr. Leffingwell and other members of the expedition shall travel down the Mackenzie River in the early summer of this year, while Mr. Mikkelsen, should he be able to obtain a suitable vessel, will leave San Francisco in April, and after spending some time on the Siberian coast purchasing necessary equipment, meet the rest of the party at the mouth of the Mackenzie some time in the latter part of August. Thence the expedition will make its way to Cape Kellet, in Banks Land, and begin the exploration of its special region. The work to be undertaken depends to some considerable extent on the arrangements which it may be possible to make with regard to the fitting out of a ship.

AT a meeting at the Royal United Service Institution on January 18, Major Goodwin, D.S.O., delivered a lecture on "Military Hygiene on Active Service." After briefly describing the origin and causation of those diseases which affect armies in the field, and discussing and comparing the statistics of the Boer and Russo-Japanese wars, the lecturer suggested that there are two principal measures, which, if organised and perfected, will entirely remedy, in his opinion, the great evil which has existed in the past. The first measure is sanitary organisation—a corps should be formed of officers and men specially trained in all the methods of sanitation—the second is the necessity for the further education of regimental officers and men in sanitary principles.

THE annual general meeting of the Entomological Society of London was held on January 17. Mr. F. Merrifield, the president, read an address on the general operation of temperature on the growing organism of lepidopterous insects, based on a series of experiments, especially with reference to the remarkable limitations imposed by climatic and artificial conditions. The report of the society showed that for the first time in its history the number of ordinary fellows had reached five hundred. The officers and council were elected for the session 1906–7 as follows:—President, Mr. F. Merrifield; hon. treasurer, Mr. A. H. Jones; hon. secretaries, Mr. H. Rowland-Brown and Commander J. J. Walker, R.N.; librarian, Mr. G. C. Champion; other members of the council, Mr. G. J. Arrow, Mr. A. J. Chitty, Mr. J. E. Collin, Dr. F. A. Dixey, Mr. H. Goss, Mr. W. J. Kaye, Mr. H. J. Lucas, Prof. E. B. Poulton, F.R.S., Mr. L. B. Prout, Mr. E. Saunders, F.R.S., Mr. R. S. Standen, and Mr. C. O. Waterhouse.

DR. H. J. P. SPRENGEL, F.R.S., the inventor of the mercury air-pump, whose death we announced last week, was for three years an assistant in the chemical laboratory

of Oxford University; afterwards he worked in the laboratories of Guy's and St. Bartholomew's Hospitals, London. He was elected a Fellow of the Royal Society in 1878. His air-pump, which he described to the Chemical Society in 1865, led to results which had an important influence on the development of both science and industry in the latter part of last century. It provided a convenient method of obtaining vacua of very high tenuity, and contributed greatly to the perfection of the incandescent electric lamp. Dr. Sprengel devoted much time to the study of detonation and explosives, and in 1871 took out patents for a class of explosive substances which were non-explosive during their manufacture, storage, and transport. He was the first to direct attention to the value of picric acid as an explosive when fired by a detonator. In addition to papers on his vacuum pump and kindred subjects, Dr. Sprengel published the following contributions to science among others:—Atomised water as a substitute for steam in a chemical process, 1873; improvements in explosive compounds, 1871; on a new class of explosives, 1873; the Hell-Gate explosion near New York and so-called "Rackarock," 1886; the discovery of picric acid as a powerful explosive and of cumulative detonation with its bearing on wet gun-cotton, 1902.

THE fifty-fifth meeting of the American Association for the Advancement of Science was held at New Orleans, and began on December 29 last. The membership of the association has now reached 4500. It has been decided to hold two meetings during 1906, one in the summer at Ithaca, N.Y., the other in the winter at New York City. At the recent meeting, the address of the retiring president, Prof. W. G. Farlow, dealt with the popular conception of a scientific man at the present day. The presidents of the different sections delivered their addresses on various days throughout the meeting. Prof. Ziwet, at the first meeting of the section of mathematics and physics, took for his subject the relation of mechanics to physics. Prof. Kinnicutt, in the section of chemistry, considered the sanitary value of a water analysis. Prof. Merriam, in the section of zoology, discussed the question, Is mutation a factor in the evolution of the higher vertebrates? The subject of the partition of energy was taken up by the president of the physics section, Prof. Magie; and the generic concept in the classification of the flowering plants was dealt with by Prof. Robinson in the section of botany. Prof. Knapp, in the section of social and economic science, considered the subject of transportation and combination. In the section of mechanical science and engineering, Prof. Jacobus addressed the meeting on commercial investigations and tests in connection with college work. The experience at New Orleans makes it doubtful whether the experiment of scattering the addresses of the presidents of sections through a week is a wise departure.

WE have received copies of the reports of the Bristol Museum and Reference Library for 1904, and of the Bristol Museum and Art Gallery for 1905. The change in the title of the institution is due to the opening of the Art Gallery, which took place in February of last year, when the inaugural address was delivered by the late Prof. Herkomer. About the same time Mr. F. G. Pearcey entered the museum as assistant curator, and since his appointment a thorough re-arrangement of the zoological exhibits has been undertaken, while large additions have been made by gifts and purchase.

BOTANICAL surveys undertaken with the object of studying the distribution of plants over a limited area have been prepared by several workers in Scotland and England. Mr. G. H. Pethyridge and Mr. R. L. Praeger publish in the *Proceedings of the Royal Irish Academy* (vol. xxv.) a survey of the vegetation of the district lying south of Dublin. The authors distinguish four zones, littoral, agrarian, hill pasture, and moorland. It was observed that the three associations of *Ulex Europaeus*, *Ulex Gallii*, and Calluna maintain a definite succession in altitude, *Ulex Europaeus* occurring at the upper limit of the agrarian zone, and Calluna forming the most important feature of the moorland. The association in which Pteris is the dominant member occupies positions in each of the three former associations, holding its own where it is favoured by well-drained soil and a sheltered situation. The paper is accompanied by six illustrations, of which the one reproduced shows the characteristic rounded hummocks of *Ulex Gallii* in the foreground; in the background the farmland is seen below with *Ulex Europaeus* just visible in the middle distance and Calluna clothing the summit of the hill.

Photo. *R. Welch.*

FIG. 1.—Piperstown Hill, showing, in ascending order, farm land, *Ulex Gallii* association, and Calluna association.

THE educational advantages of the Central Museum at Brooklyn, New York, form the subject of the first article in the January issue of *Museum News*, in which attention is specially directed to the exhibits of typical groups of mammals, birds, and reptiles. It would seem, however, that the museum authorities themselves stand in need of education, otherwise they would scarcely have stated "that the present revolution in Russia bids fair to complete the extermination of the European bison by killing off the Lithuanian herd." They appear to be quite unaware of the existence of this animal in a truly wild state in the Caucasus.

In addition to several papers relating to the human subject, the January issue (vol. xl., part ii.) of the *Journal of Anatomy and Physiology* contains contributions on the anatomy and development of the lower mammals. Among these is one by Dr. T. H. Bryce on the development of the thymus gland in the lung-fish, *Lepidosiren paradoxa*, in the course of which the author arrives at the important conclusion that, at least up to an advanced larval condition, this organ has absolutely nothing to do with the development of leucocytes. Apparently the leucocytes take origin in a tract along the hind kidney, and, at any rate, there is evidence of their existence before the thymus cells have lost their epithelial characters. In another paper Prof. Symington discusses the bearing of the structure of fœtal whale-flippers on the development of additional digits and joints in the hand and foot of vertebrates generally. In cetaceans the suppression of nails or claws has led to the development of a cartilaginous rod at the end of each digit which is apparently a reversion to the primitive mammalian condition. "Such a condition would obviously facilitate the development of additional cartilaginous elements to adapt the limb to its newly acquired function as a balancing and steering organ." Hence the occurrence of "hyperphalangism" is easily accounted for, while indications of incipient "hyperdactylism" are afforded by rudiments in some cases of the development of a sixth digit.

In the annual report of the Botanical Department, Trinidad, for the year 1904–5, the superintendent, Mr. J. H. Hart, directs attention to the advantages of budded over seedling oranges in maintaining the qualities of any selected strain. Trinidad oranges have been successfully transported to England from time to time, and last year a consignment of mangos was sent over that carried well, and was said to compare favourably with the best Indian fruit. Among shade trees for cacao, *Gliricidia maculata*, the "Madura" of Central America, has been in considerable demand, and Honduras mahogany has also been planted. The cotton experiment plots suffered severely from the "boll rot."

Mr. D. McAlpine records in *Annales Mycologici* (vol. iii., No. 4, 1905) the discovery of a peculiar set of rusts on species of Acacia in Australia that he places in a new genus, Uromycladium. The characteristic of the genus is a branched carpophore producing at the ends of each branchlet one to three separate teleutospores, or in place of one of the teleutospores a colourless vesicle or cyst. Mr. McAlpine regards the genus as a link between Uromyces, which has a single teleutospore, and Ravenelia, a peculiar genus in which the stalk is compound and a number of spores are joined together at the top, with vesicles below. Of the seven species enumerated, uredospores and spermogonia are known for some, but no æcidia have as yet been found.

The *Times* of January 12 contains a comprehensive summary of the rainfall of 1905, by Dr. H. R. Mill. The work is valuable from a double point of view—from the vast amount of material relating to the rainfall of the British Islands that Dr. Mill has at his disposal, and from the almost incredible shortness of time in which he has been able to compile his statement, in advance of the usual annual rainfall volume, which takes at least six months to produce. The author points out that during an average year no spot with a fall of less than 20 inches appears on the rainfall map of Great Britain; last year there were about 7500 square miles, while the area with rainfall exceeding 40 inches measured some 29,000 square miles, or less than a quarter of the country. In an average year more than a third of the area of the country has a greater fall than 40 inches. A table based on a thirty years' average which accompanies the paper shows that none of the fifty-one stations quoted for England and Wales reached the normal amount, that only one did so in Ireland, and about half the stations in Scotland. From these figures Dr. Mill estimates that the general rainfall for England and Wales was only 83 per cent. of the average; for Ireland, 89 per cent.; for Scotland, 96 per cent. In other words, for every inhabitant of the British Isles there was last year 224,000 gallons less rain than in an average year. Further, that the year 1905 has justified the three years' cycle of one wet year followed by two dry years; the probability of 1906 proving a wet year has not been contradicted by the weather of the first half of January.

Mr. van der Grinten, whose projection of the whole globe in a circular map, published last year, attracted considerable attention, deals with another case—that of the "apple-slice" shape—in *Petermann's Mitteilungen* (p. 237, 1905).

Dr. Gerhard Schott contributes a paper on the relief of the bed of the Southern Ocean, and the distribution of bottom temperatures, to *Petermann's Mitteilungen* (No. 11, 1905). The soundings and temperature observations of recent expeditions are made use of, and the author has compiled an admirable bathymetrical chart showing the state of our knowledge of the region in 1905.

The *Zeitschrift der Gesellschaft fur Erdkunde* (No. 9, 1905) contains a paper on the geographical conditions determining the distribution of moorlands, by Dr. F. Solger. The chief factors taken into consideration are rainfall, surface topography, and elevation, and the relations of these three factors in different types of moorlands are discussed.

The publishers of *l'Elletricista* have issued a useful little book, by Dr. G. Agamennone, under the title of "La Registrazione dei Terremoti." The words "in Italia" should have been added to the title, as the book is confessedly devoted to Italian work, and hardly refers to that which has been done elsewhere, especially in Japan, where the ideas embodied in the Italian instruments were, with few exceptions, anticipated in the publications of the Seismological Society of Japan. The omission is justified by the plea of the author that any attempt at adequate recognition of the work done in other countries would have swollen the book to an undesirable size; as it is, we have a well got up and clearly written account of the seismoscopes and seismographs used in Italy, which are singularly efficient if somewhat more cumbrous than the English or Japanese patterns.

The *Rendiconto* of the Bologna Academy (vols. v.–vi.), covering the period 1900–2, has just been sent out. It contains a series of illustrated papers by Dr. Francesco Crevatin on the terminations of nervous systems; also papers by Prof. Augusto Righi on the magnetic field of a moving charge and on the acoustic properties of condensers, by the late Prof. Emilio Villari on the heating effects of electric discharges and on Röntgenised air, by Prof. Ferdinando Paolo Ruffini on the three cusped hypocycloid, and others.

We have received the annual report of the Circolo Matematico di Palermo, which shows an increase in its membership roll from 27 in March, 1884, and 195 in

March, 1904, to 255 in March, 1905. Of these 36 are resident, 138 non-resident, and 81 foreign members. The society owes its present position as a mathematical society of international rank largely to the personal exertions of Prof. Guccia, and further evidence of this activity is shown by the offer of a "Guccia medal" and prize of 3000 francs, to be awarded at the mathematical congress at Rome in 1908, for the best essay marking an advance in the theory of algebraic twisted curves.

MR. HENRY FROWDE has published an edition of Wordsworth's "Guide to the Lakes," with an introduction, appendices, and notes by Mr. Ernest de Sélincourt. Though Wordsworth is, throughout the book, rather the lover than the student of nature, yet the volume contains much that will appeal in a special manner to men of science—for example, the remarks on stone circles—and everything the volume contains will serve to increase the enthusiasm with which scientific students approach natural phenomena.

THE 1906 issue of their "Nature Calendar" has been published by Messrs. George Philip and Son, Ltd. It is a little difficult to understand the plan on which the notes for the months have been arranged, and on what principle the entries for successive days have been selected. Under the date January 25, for instance, are to be found the following statements:—"Jackdaws begin to come to churches"; "First appearance of Yellow Wagtail"; and "Honeysuckle leafing." A young, uninitiated nature student, who observed a jackdaw going to church, or came across a yellow wagtail, or found honeysuckle in leaf before January 25, might have his faith in naturalists' calendars seriously shaken.

A SECOND edition of Prof. Douglas H. Camphell's work on "The Structure and Development of Mosses and Ferns" has been published by Messrs. Macmillan and Co., Ltd. The first edition was published in 1895, and was reviewed at length in our issue for January 2, 1896 (vol. liii. p 194). Portions of the work have been re-cast entirely, this being especially the case with the eusporangiate ferns. The whole book has been carefully revised and new matter has been introduced, including two special chapters on the geological history of the Archegoniates and the significance of the alternation of generations. Some of the new material is published now for the first time, but much of it is based upon papers written by Prof. Campbell during the last ten years.

OUR ASTRONOMICAL COLUMN.

PERIODICAL COMETS DUE TO RETURN THIS YEAR.—Writing to the *Observatory* (No. 366), Mr. W. T. Lynn directs attention to the fact that two known periodical comets are due to return during the present year—Holmes's comet in the spring, Finlay's in the summer. The former has already been noted in these columns. Finlay's comet was discovered at the Cape on September 26, 1886, and performed its perihelion passage on November 22 of the same year; its period is about 6·6 years, and on its return in 1893 it was first seen by the discoverer himself, and passed perihelion on June 16. On its return in 1899 the comet was unfavourably situated for observation, and so escaped detection.

A note published in No. 1, vol. xiv., of *Popular Astronomy* mentions six other periodical comets as being due this year, viz. Barnard's (1884 II.), E. Swift's (1894 IV.), Denning's (1881 V.), Swift's (1889 VI.), and the two lost comets, Biela's and Brorsen's. Of these, the first and second will be unfavourably placed for observation; the third has not been seen since 1881, but will be more favourably placed this year; the fourth was very faint in 1889, and any small change in the period may have rendered it wholly invisible.

THE ANNULAR NEBULA IN CYGNUS (N.G.C. 6894).—An interesting photographic study of the very faint annular nebula N.G.C. 6894 has recently been made at the Meudon Observatory by M. G. Tikhoff. Using the 39-inch reflector, the observer obtained four photographs, of which he has measured the two best, taken on September 27 and October 27 with exposures 2h. 20m. and 3h. respectively.

These photographs showed the nebula to have the form of an elliptical ring with a condensation in the centre, the space between the nucleus and the outer ring being fairly bright. The extremities of the major axis of the ellipse are sharp, but several faint appendices are clustered around the ends of the minor axis. Measurements of the plate obtained on September 27 showed the length of the major axis to be $44''.8$, that of the minor axis $37''.3$, but if the appendices be included the length of the latter becomes $50''.8$. The nebula really consists of two rings, a broad outer one and a narrow inner ring, but the duplication is interrupted on the north-west by the star discovered by Lord Rosse in 1855. The outer ring has several condensations in it, of which the two brightest are nearly opposite to Lord Rosse's star.

M. Tikhoff recalls the fact that all observers of this nebula have commented on its similarity to the ring nebula in Lyra, and advances the opinion that it is probably in a later stage of development, for whereas the Ring Nebula has only one condensation, this Cygnian nebula has many.

RIGHT ASCENSIONS OF THE EROS COMPARISON STARS.—In Nos. 4059–4060 of the *Astronomische Nachrichten*, Dr. Fritz Cohn, of Königsberg, gives a catalogue containing the definitive positions of the Eros comparison stars contained in the two lists iussed by the international committee. The positions are given for 1900·0, and two supplementary tables give the proper motions necessary for reducing the places of the few stars known to be in motion to the equator of 1901·0.

OBSERVATIONS OF NOVA PERSEI (NO. 2) AND NOVA GEMINORUM.—The results of a series of magnitude observations of Novæ Persei and Geminorum are given in No. 4066 of the *Astronomische Nachrichten* by Dr. K. Graff, of the Hamburg Observatory. The Nova Persei observations extend from March 11, 1902, to August 24, 1905, and show one or two apparent oscillations of the brightness. On the latter date the magnitude of this star was recorded as 10·73.

The record for Nova Geminorum contains the results of six observations made between September 16, 1903, and November 10, 1904, and shows an apparent increase in the brightness between January 20, 1904, and the final observation; the latter was, however, somewhat uncertain, and gave a magnitude of $<12·0$.

On November 28, 1905, Prof. Max Wolf found that the magnitude of Nova Persei on the Pickering scale was 11·65, but compared photographically with the stars given by Father Hagen the magnitude came out as 10·6.

DOUBLE STAR ORBITS.—Prof. Doberck publishes four possible orbits for τ Ophiuchi and two for γ Centauri in No. 4063 of the *Astronomische Nachrichten*. Of these, he finds, on comparison, that the following agree most closely with observational results:—

τ Ophiuchi	γ Centauri
$\Omega = 76^\circ\ 12'$	$\Omega = 3^\circ\ 21'$
$\lambda = 17\ 45$	$\lambda = 285\ 2$
$\gamma = 66\ 4$	$\gamma = 81\ 47$
$e = 0·5338$	$e = 0·2958$
$P = 223·82y.$	$P = 211·93y.$
$T = 1814·79$	$T = 1851·63$
$a = 1''·307$	$a = 1''·924$

The value of the hypothetical parallax for τ Ophiuchi is $0''·035$, and for γ Centauri $0''·054$. In the elements of the latter, the epoch and the longitude of periastron are somewhat uncertain, and for this star the motion is retrograde.

ECONOMIC GEOLOGY IN THE UNITED STATES.

THE energy shown by all branches of the United States Geological Survey increases year by year, and it is impossible to overestimate the importance of the results achieved during the twenty-five years of its existence. The prompt return made for the pecuniary support accorded to the survey is best shown by the numerous publications, appearing each year, which are devoted to the development of the mineral resources and to the advancement of important engineering projects. The miner is thus taught the practical value of geological work, and mining development is placed upon a scientific basis. A large number of bulletins have recently been published which, though describing researches of an essentially scientific nature, deal with the economic resources of specified districts. Half a dozen of these bulletins, well illustrating the educational value of the survey's work to those engaged in the mining industry, have been selected for brief notice. Of these the most important is No. 260, "Contributions to Economic Geology, 1904," in which Mr. S. F. Emmons and Mr. C. W. Hayes, the geologists in charge of the sections dealing with ores and non-metallic minerals respectively, bring before the public with all possible speed the economic results arrived at by the survey. The bulletin covers 620 pages, and contains sixty-three contributions from thirty-seven members of the survey who have been engaged throughout the year in economic work. The production of gold and silver in the United States in 1904 is discussed by Mr. W. Lindgren, who has made a novel classification of the ores into (1) placer or detrital deposits, and (2) ores from rock *in situ*, further subdivided into quartzose ores, copper ores, and lead ores. The percentage of the total production derived from the four classes thus established is as follows:—

FIG. 1.—Weathered Surface of Galena Limestone near Rockdale, Iowa.

	Placers	Quartzose	Copper	Lead
Gold	15·2 ...	74·3 ...	5·0 ...	5·4
Silver	0·1 ...	22·2 ...	34·7 ...	42·9

A similar calculation of the copper production of the United States, made by Mr. W. H. Weed, shows that of the copper produced 27 per cent. occurs in native ores, 6 per cent. in oxide ores, and 67 per cent. in sulphide ores. Mr. L. C. Gratton reports that the tin deposits (dykes of pegmatite carrying cassiterite) of North and South Carolina are probably of considerable economic importance; and Mr. F. L. Hess gives a concise statement of what is known with regard to tin deposits throughout the rest of the world. In the Birmingham district, Alabama, an important result of the work of the survey has been the extension of the red hæmatite ore beyond its supposed southern limit.

The fuel resources of the United States received more attention last year than at any previous time during the existence of the survey. About 3000 square miles of coal-bearing territory have been mapped, and work in the oil and gas fields has been continued. The American cement industry formed the subject of an extensive investigation by Mr. E. C. Eckel, and much valuable information is given regarding the slate, granite, and clay industries. Descriptions are also given of a molybdenite deposit in eastern Maine, and of the vanadium and uranium ore deposits in south-eastern Utah.

Bulletin No. 255, on the fluorspar deposits of southern Illinois, by Mr. H. Foster Bain, embodies the results obtained in a detailed study of the fluorspar deposits in Pope and Hardin counties, the area covered being at present one of the most important producers of fluorspar in the United States. The deposits were discovered in 1830, but were not mined until 1870. The mineral occurs in veins along faulting fissures, and is associated with calcite, galena, and zinc-blende. In 1903 the district produced 11,413 tons of fluorspar, valued at 11,544*l*. The best grade of fluorspar, with less than 1 per cent. of silica, is used in the enamelling, chemical, and glass trades. The second grade is used in open-hearth steel making to give fluidity to the slag. About 20,000 tons are used annually in this work. The lowest grade is used in foundry work.

The zinc and lead deposits of north-western Illinois are dealt with in Bulletin No. 246 by Mr. H. Foster Bain. The region contains large reserves of zinc ore of good quality. The main ore-bearing rock is a thick massive dolomite, known as the galena limestone. Owing to the predominance of solution over disintegration, it presents on weathered surfaces a very characteristic carious surface (Fig. 1).

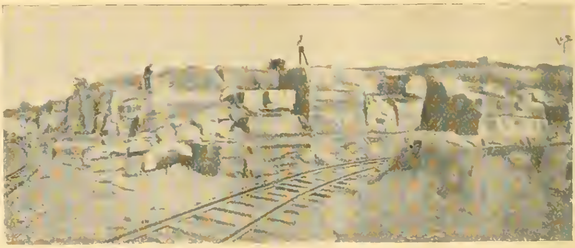


FIG. 2.—Vanport Limestone Quarries at Newcastle, Pennsylvania.

Bulletin No. 249, on limestones of south-western Pennsylvania, by Mr. F. G. Clapp, is of great economic interest in view of the recent extension of the portland cement industry. It points out promising localities for the erection of cement plants in the coal areas of Pennsylvania. As a rule, these Carboniferous limestones are not suited for building stone, but many of them, when burned, form lime of excellent quality for agricultural, building, and fluxing purposes. The Vanport limestone, the most per-

sistent, thickest, purest, and most massive limestone in the series, is extensively quarried for furnace flux at Newcastle (Fig. 2).

In Bulletin No. 238 Messrs. G. I. Adams, E. Haworth, and W. R. Crane give detailed information concerning the geology of the Iola Quadrangle, Kansas, a rapidly developing petroleum and natural gas field. At the end of 1903 there were 1596 producing wells in Kansas, and of these 549 were at Chanute (Fig. 3) and 339 at Humboldt in the area under consideration. Natural gas is abundant in the vicinity, and is largely used in zinc smelting. Indeed, more than half the zinc made in the United States is smelted by Kansas gas, and more than half of this is produced at works within the Iola quadrangle.

FIG. 3.—Golden Oil Company's Well No. 2, near Chanute, Kansas.

Bulletin No. 264, by Messrs. M. L. Fuller, E. F. Lines, and A. C. Veatch, gives a record of deep-well drilling for 1904, and is the first of a proposed series of annual publications. The report embodies the records of a large number of wells, for many of which sets of samples are preserved.

THE APPLICATION OF SCIENTIFIC METHODS TO THE STUDY OF HISTORY.[1]

THE remarkable change which during the last fifty years has passed over most subjects of study owing to the growing dominance of the scientific spirit has not left history unaffected. The leading historians of the present day are essentially men of science. They are diligent in their pursuit of truth and skilled in the special methods of research which their subject demands. They are strikingly impartial in their judgments, constantly on their guard against the prepossessions so liable in matters of past politics to bias opinion. They are ever on the alert to discover unifying principles, general laws, large uniformities, without which no body of historic facts, however accurately ascertained and however impassionately selected, can justify the claim of history to be regarded as a science, or can make history worthy of the serious attention of intelligent men.

All the writers enumerated at the foot of this column deal in some shape or form with this transference of history from the domain of literature to the domain of science. None states the fact of the transference more clearly than does Prof. Bury, who says (p. 16):—"I may remind you that history is not a branch of literature. The facts of history, like the facts of geology or astronomy, can supply material for literary art . . . but to clothe the story of a human society in a literary dress is no more the part of a historian as a historian, than it is the part of an astronomer as an astronomer to present in an artistic shape the story of the stars"; and again (pp. 7 and 42) he emphatically asserts that "History is a science, no less and no more." But though this statement is perhaps more explicit than any other in the works before us, yet the idea which it expresses is common to all.

It is not enough, however, to assert that a subject, long regarded as a branch of literature, is really a science. It is necessary to define its scope, to expound its method, and to show its relation to other sciences. This our authors do in varying degrees of fulness, and it would be a profitable, and I think not uninteresting, task to take them one by one and to analyse their views. But in an article like the present it is not possible to undertake this detailed examination, and I must content myself with giving a summary statement of the way in which scientific method has been applied to history, and of some of the results which have been attained.

It is a curious and remarkable fact that the earliest of the above-named exponents of the science of history, Droysen and Froude, were called upon to cast their first clear utterances upon the subject into the form of a severe castigation of a too zealous champion of their own view, H. T. Buckle. Buckle had become possessed of the great idea commonly associated with the name of Comte, viz. that "all phenomena without exception are governed by invariable laws with which no volitions natural or supernatural interfere," and in his "History of Civilisation" (1858–61) he had endeavoured with wonderful ingenuity and vast learning, not so much to elevate history to the rank of a science as to reduce it to the level of a *physical* science, with laws of the same rigidity and of the same universal applicability as the laws of motion or the laws of chemical affinity. This was going further than either the most advanced historians or the least exclusive philosophers would allow, and a keen controversy ensued, out of which at length emerged into general recognition the important fact that history differs from the natural sciences in at least two respects, first, that, with regard to its method, it is a science, not of observation or of experiment, but of criticism; secondly, that with respect to its generalisations, since they deal with a realm, not of matter, but of mind, in which motive and not force is supreme—a realm of consciousness and freedom—they can never have that fixity and universality which are connoted by the term "law."

On the other hand, historical phenomena are not permanent, but evanescent. Events happen once, and then fade beyond recall into the past. Observations made at the moment of their happening can never be repeated, and historians are dependent for all their knowledge of bygone events upon such records as may chance to have been made and to have been preserved. These records are the only present and concrete facts with which historians come into contact. These are the basal material of their science. But they are valuable and important, not at all for their own sake, but only for what they reveal. They reveal past facts, yet even these not directly, but past facts as seen through the refracting medium of the human mind. And when the historian has eliminated, so far as he can, the personal factors for his records and has extracted such pure and unadulterated fact as remains, even then he has not come to the end of his research. Far beyond and beneath all events there lie the thoughts, the acts of will, the emotions of which they were the realisations and manifestations—ultimate facts of the human spirit wholly beyond the observation even of those in whose midst the events transpired. It is these for which in the last resort he seeks. Thus, as has been remarked, history is a science, not of observation, still less of experiment: it is a science of criticism.

On the other hand, with regard to generalisation and law, the fundamental truth to be recognised is that history never repeats itself. The phenomena of history are not

[1] (1) "Erhebung der Geschichte zum Rang einer Wissenschaft" By J. G Droysen. (1862.)
(2) "The Science of History." By J A. Froude. (1864.)
(3) "Grundriss der Historik" By J. G Droysen. (1867)
(4) "The Science of History" By Principal John Caird. (1886)
(5) "Introduction aux Études Historiques" By Langlois and Seignobos. (1897.)
(6) An Inaugural Lecture. By Prof J. B. Bury. (1903.)
(7) "A Plea for the Historical Teaching of History." By Prof. C. H Firth. (1904)
(8) "The Methodical Study of Man" By Dr. Percy Gardner. (1904.)

stationary like those of the experimental sciences which can be called up at will at any moment; they are in constant movement. Moreover, their movements are not cyclical, like the movements of the planets; they are progressive in an infinite series. Every event which occurs adds something to the environment of every subsequent event and is a factor in its causation; so that the mere fact that a thing has happened once presents an insuperable barrier to its ever happening again. We of the present day, for instance, are divided by an impenetrable wall of new ideas, new discoveries, new conditions from our predecessors of but the last generation. Not even the most deliberate and carefully planned attempts to revert to earlier orders of things—social, religious, political—can possibly result in anything but hopeless failure. History can never be *made* to repeat itself.

That being the case, it is obvious that whatever may be the general principles which historians may deduce from their study of historic phenomena, they will be very different from the rigid and invariable laws of natural science which enable the expert not only to explain the past, but also to predict the future. History, in fact, has closer analogies with the mental and moral sciences than with the natural sciences. It is to the human race almost exactly what memory is to the individual man. No individual man ever finds himself twice in precisely the same situation, nor can anyone discover unvarying sequences of cause and effect in the relations between himself and his fellows; yet, notwithstanding this, every man in his mature life is very largely guided and governed by his experiences as recorded by his memory and by the principles of conduct which his judgment has deduced from them. As with the individual so with the race; but subject to this important difference, that the race lacks that personality, that continuity of self-consciousness, which marks the individual. It has no natural memory, and in order that it may not lose the vast accumulated wealth of the experiences of the past a memory has to be created for it. That race-memory is history. Through history mankind attains to self-consciousness. As Droysen puts it:—"Die Geschichte ist das γνῶθι σαυτὸν der Menschheit, ihr Gewissen." By means of this self-knowledge humanity is able to become to a degree otherwise wholly impossible the master of its fate; it is able to control its destiny, and to move deliberately forward on the pathway of progress.

Now if history is to perform adequately its high function, and to serve the purpose of a universal memory to man, it is plain that it must no longer be left in the hands of the literary artist to be built up of anecdotes, be they told never so brilliantly, or in the hands of the party-politician to be constructed of half truths, be they never so honestly held to be the whole truth. History must be elaborated by the strictest methods of science, even though it is concerned with facts which are beyond the reach of observation and with principles which are not reducible to the satisfying simplicity of law. To state the matter in the briefest outline, which is all that is possible here, scientific method must be applied to history, first, in the discovery of facts; secondly, in the selective classification of facts; and thirdly, in the drawing of inferences from facts.

(1) *The Discovery of Facts.*

In history, the discovery of fact resolves itself mainly into the criticism of documents. So important are documents in historical research that MM. Langlois and Seignobos go so far as to say, in the opening paragraph of their book, "L'histoire se fait avec des documents," and "Pas de documents, pas d'histoire." There *are*, however, other sources of information, for example, oral tradition in the case of contemporary or recent events; archæological, architectural, and monumental remains in the case of more remote eras. Nevertheless, it is correct to say that documents are the primary source of historical knowledge. Concerning documents, the first thing which has to be determined by criticism is their origin—that is to say, their authorship, the date and place of their composition, and their genuineness. Many things have to be taken into account in the determination of these important matters, *e.g.* handwriting and writing materials, vocabulary, internal evidence of knowledge displayed and opinions expressed. When, so far as is possible, the origin of a document has been fixed and its genuineness proved, the problem of the accuracy of its statements has to be entered into. Such questions have to be asked as:—Had the writer opportunities of knowing what he wrote about? Had he sufficient ability to avail himself of his opportunities? Had he any prejudices to distort his judgment? Had he any reason to conceal or pervert the truth? Does his testimony agree with that of other witnesses? Is what he says inherently credible?

(2) *Selection and Classification of Facts.*

The fact that a fact is a fact does not make it important. The historian has to select the facts which are significant from vast masses of the insignificant. What shall be his principle of choice? Shall he select anecdotes which may amuse his readers, or incidents which support the views of some party or sect to which he belongs? The day when he could adopt either of these principles of selection is gone. But even now historians do not by any means agree as to the exact kind of facts that it is the function of history to record. Nor is it necessary that they should agree; no two people store their memory with precisely the same kind of recollections. Seeley and Freeman limited themselves to facts of past politics; Green and Macaulay recorded facts of past social conditions; Droysen and Döllinger, following Schopenhauer and Hegel respectively, looked below the surface of events, the one for the acts of will, the other for the movements of ideas of which events were the manifestation. Any one of these principles, or any similar principle, is sufficient to give a scientific unity to historical research.

(3) *The Drawing of Inferences from Facts.*

Although, as already seen, historical inferences can never have the characteristics of physical laws, and although the completest philosophy of history could never enable the historian to predict revolutions with that unerring certainty with which the astronomer predicts eclipses, yet historical inferences may be thoroughly scientific, and the philosophy of history of the greatest practical value. Given the permanent and unchanging facts of human nature, and known the peculiar circumstances of any particular event, that event can be explained; and though it is true that these circumstances can never by any possibility recur again, yet others will certainly occur sufficiently similar to make the explanations discovered in the one case valuable guides to conduct in the others. Social and political progress and the development of civilisation depend very largely on the adequate learning by the human race of the lessons of experience remembered by means of history.

If in our days kings are benevolent, churches are tolerant, armies are obedient, and policemen are civil; if colonies are well governed; if taxation is equitable; if Ministers of State are honest—all this is due no little to the recorded and thus remembered fates of tyrants, persecutors, rebels, and the rest. Similarly if the admitted imperfections of the present are to be removed, and if progress is to continue, history, rich with its lessons of the past, must remain the light and guide of the future. But it must be not the history of superstition and prejudice and romance, not the boon companion of astrology and alchemy, but the history of exact knowledge and calm judgment, the recognised members of the hierarchy of the sciences.

F. J. C. HEARNSHAW.

PUBLIC SCHOOLS SCIENCE MASTERS' CONFERENCE.

THE annual meeting and conference of the Public Schools Science Masters' Association was held on Saturday, January 20, at Westminster School. Owing to ill-health, which had forced him to go abroad, the president, Sir Oliver Lodge, was unable to be present, and the Rev. E. C. Sherwood (Westminster), chairman of committee, presided at the business meeting, his place being afterwards taken by the retiring president, Sir Michael Foster, K.C.B. The honorary secretary, Mr. W. A. Shenstone (Clifton), relinquished his post, and the Rev. E. C. Sherwood (Westminster) and Mr. Hugh de Havilland

(Eton) were elected to serve in a joint capacity. Mr. J. Talbot (Harrow) was re-appointed treasurer, and the Rev. the Hon. Canon Lyttelton, headmaster of Eton, was unanimously elected president for the year 1907.

Sir Michael Foster, in opening the conference, excused himself from giving an address on the ground that for some time his mind had been filled with very inferior things (Sir Michael referred to the contest for the representation of London University in Parliament). The first paper was read by the Rev. W. Madeley (Woodbridge); its aim was to invite discussions upon the possibility of introducing a comprehensive syllabus of scientific teaching within the time limits of a classical curriculum. Mr. Madeley characterised the fact that there was no compulsory science on the classical sides of public schools as a deplorable anachronism. He pointed out, too, that philosophy was introduced into the classical honours papers at Oxford, and that classical scholars were expected now to know what was meant by the "struggle for existence," "survival of the fittest," "the Glacial epoch," and "the laws of motion," as shown by questions set in examination papers. He suggested that two hours alone per week could be spared in which classical boys could do science, and outlined a general course of what he termed natural philosophy, which he thought would broaden the outlook of the boys and do more for their general education than a training in some special branch of science. Among the items in his syllabus were gravitation, the solar system, the conservation of energy, the indestructibility of matter, the laws of chemical change and combination, Darwinism and evolution.

Sir Michael Foster, in the discussion which followed, said that he sympathised with the wish of Mr. Madeley, who had given them a problem to solve and mentioned the time in which it had to be done. He went on to say that the whole use of science was dependent upon the habit of mind that was acquired, and this, which meant openness, alertness, and power of observing many things, could not be gained by surveying the whole world of science, but by attendance to details. When these had been mastered broader views and generalisations could more easily be grasped.

Mr. W. D. Eggar (Eton) advocated that the two hours should be devoted to laboratory study, and that a very small bit of science should be thoroughly taken up. No lectures should be given, as the boys could read up notions for themselves. Mr. D. Berridge (Malvern) thought that if classical masters prepared a number of foreign phrases for the science boys to learn, so that those met with in the newspapers could be understood, they would be as well equipped from the literary point of view as Mr. Madeley's boys would be in science by the course which he had outlined. Mr. Berridge agreed that the division of the lower school into classical and modern sides militated against the taking of science on the former of these. He suggested that headmasters should try the experiment of making, say, the five subjects of the old London matriculation compulsory for all boys until they were sixteen years of age and ready to specialise. Mr. W. A. Shenstone (Clifton) asked why boys might not have the special and the general training as well, and advocated, in addition to the two hours' work at a particular branch in the laboratory, the attendance of the boys once a fortnight at general lectures, such as those lay addresses given at Clifton on Sunday evenings. Many speakers emphasised the ignorance of the classical boy and man. Mr. Cumming (Rugby) said that the only instrument that they understood when they left school was the pen.

Mr. J. Talbot (Harrow) read the second paper, on the present state of the Army examinations, and began by alluding to the changes which have recently taken place, not only in the standard and arrangement of subjects, but also in their very nature. As he considered that the changes were permanent, he went on to trace the reason for them. For this we must go to South Africa, for the recent war has altered the whole principles underlying the tactics and training of the Army. As Colonel Henderson has pointed out, the discipline used to be entirely mechanical, killing all individuality, and forbidding either officer or man to move without direct order; now, as he says, soldiers must be like a pack of well trained hounds, not running in regular order, but without stragglers, each using his instincts and intelligence, and following up the general aim with relentless perseverance.

Under the old conditions, Mr. Talbot said, brains were not essential in an officer, and any type of entrance examination would do, and did. Now, however, if each officer is to employ the trained initiative which is essential in the new order of things and produce it in his men, it is obvious that his own training as a boy becomes all important. While Woolwich and Sandhurst supply the purely technical training, the science masters have to supply the mind they train, and this must be well developed, inured to hard work, and, above all things, supple.

We are now in a position, continued Mr. Talbot, to understand the division of the examination into two parts. The qualifying examination, or its equivalent, the leaving certificate, is intended to ensure that the boy has a sound general education, the competitive, that he has brains, and unless the standard of the examination is fairly high it is difficult to discriminate between brains and cram.

One of the chief qualifications of the officer is the power of initiative; he is always meeting fresh problems, the solution of which, right or wrong, must be found quickly, and on its correctness the lives of his men and possibly of a whole army may depend. No method of teaching which Mr. Talbot had found makes more demand on a boy's power of drawing conclusions and acting on them than the practical work in the laboratories. For this reason science should be compulsory in the qualifying examination, though not in the competitive one as it at present stands. Certain things militate against the adoption by candidates of science—the want of laboratory accommodation, the fact that the alternative subject, Latin, can be taught to all the boys at once, and that there are two examinations. In larger schools Mr. Talbot fancied that science is doing well in the struggle for existence. In conclusion, science masters were told that they could no longer grumble at a reactionary War Office; they must see to it that it is not able to talk of antiquated teachers. It would be a bad thing for the schools if there ever arose a military Osborne to supersede the science masters.

Sir Michael Foster bore out what Mr. Talbot had to say about the two halves of the examination. The committee on military education had had to face the fact that many an officer could not spell, and had no knowledge of accounts. The qualifying examination was to ensure that the candidate should at least be able to write a letter, and the competitive to prove that he had brains, and, being able to use them in some directions, might be likely to do the same in others. Subsequent speakers made it clear that many boys at the public schools took science in the qualifying examination if not in the other. The discussion turned afterwards on the difficulties of, and objections to, the practical examinations in science, especially when no examiner came to conduct them. As an alternative, it was suggested that the production of note-books kept in the laboratory to show that the candidate had been through a proper course of training should be accepted in lieu of practical tests, and should determine whether the owner should be allowed to sit at the theoretical examination.

An exhibition of scientific apparatus by various makers and members of the association was arranged in the laboratories of Westminster School in connection with the meeting. Two novelties were shown by Messrs. Brown and Son; the first was a combination of the conical condenser from their "Desideratum" still with a hot water oven, the hot water from the top of the condenser being used to feed the jacket of the oven. The other was a new suction and blast apparatus dependent upon water pressure, which worked almost instantaneously. Among the exhibits of the science masters themselves was a very neat method of rocking a flask or other vessel by placing under one edge of the circular base of the stand supporting it an india-rubber tube through which a current of water is passed. The Rev. E. C. Sherwood exhibited this, and also some exceedingly useful clamps designed by Mr. Barnes. Though adapted for almost any work, those shown were used by Mr. Sherwood on retort stands, and are wonderfully ingenious and effective. A spring prevents the clamp from sliding rapidly down the rod when the screw is released; the tightening of the latter not only fixes it on the

rod, but holds the arm perfectly immovable in any position, three contacts being made. The arm will support any weight that will not actually break it. On some clamps a micrometer screw allows the arm to be moved while supporting the full weight that it can carry. Those who have struggled with the old type of retort stand clamp which wobbles in all possible directions will welcome the new invention should it be put upon the market.

WILFRED MARK WEBB.

THE THIRD TANGANYIKA EXPEDITION.[1]

I LEFT London for Cape Town on March 24, 1904, proceeding thence to Chinde, and up the Zambesi and Shiré Rivers, to Blantyre and Zomba, in British Central Africa. In Zomba I reported myself to Sir Alfred Sharpe, and from him received much advice and assistance before leaving shortly for the Upper Shiré and Lake Nyasa. In the region of this lake I stayed, roughly, three weeks—one week on the gunboat anchored at the south end, one week ascending the lake, and a week in Karonga before starting to cross the plateau to Tanganyika.

I collected, as far as possible in the short time, specimens to illustrate the flora of the lake—dried specimens, algæ scraped from rocks, &c., and tow-nettings containing diatoms and other of the more minute organisms. I made no systematic attempt to collect fish, but brought a few specimens, in addition to some leeches, crabs, a species of prawn (of interest as none had been recorded hitherto from the lake), and a sponge.

Karonga was left on July 5, and after an unavoidable delay on account of illness among my men, I arrived at Niamkolo, at the south end of Tanganyika, on July 27. I made this spot my headquarters for more than two months, though during the period I stayed a week at Kituta. I purchased at once a large dug-out canoe and hired a crew, so that I was able from the first to fish, dredge, and take tow-nettings. Meanwhile, I made arrangements with the owner of a large dau in Ujiji to hire his vessel, and this was dispatched to the south end of the lake to pick me up. I sailed on board the dau on September 23, and for the rest of my time on the lake cruised about, visiting as far as possible the most interesting and likely places on the lake shore. I camped on land whenever circumstances permitted, but my stays varied, according as I found much or little of value to me. Although I made some attempts, I found it almost impossible to dredge satisfactorily in deep water by means of the dau, so I was reduced to dredging from the canoe, in which case, of course, we had not sufficient power to dredge at any depth. On one occasion, by the kindness of the captain, I was permitted to make an attempt from the German gunboat, but unfortunately I lost the dredge and a large part of the rope, by the snapping of the rope under the strain.

I collected fish on every possible occasion, but though we tried various methods of catching them, the majority were obtained direct from the native fishermen. The largest fish I saw was a Siluroid (probably Clarias), 155 cm. in length, and weighing 30·6 kilograms. Tow-nettings were taken systematically at various times before and after dark, in various places and at various seasons. These consisted, as a rule, principally of phyto-plankton, but there were also prawns, copepods, ostracods, and insect larvæ taken in this fashion. The quantity of material obtained by tow-netting became markedly less during the rainy season. The larger representatives of the flora were also collected, but show, on the whole, little difference from the corresponding water-weeds of Nyasa. Scrapings from the rocks and submerged stems of plants produced various of the smaller algæ, while a few fungi were brought from the rotting wood of the canoe.

Five or six species of prawns were collected, in addition to those already known from the lake, some among the rocks at the water's edge, others by dredging in a few fathoms. Some two or three species of crabs were obtained, and at least two species of Argulus. These latter were perhaps most common from the mouth-cavity, gill-bars, and surface of the body of various large Siluroids, but they were also frequently present upon large specimens of Lates, and occasionally on other scaly fishes. Two forms of true parasitic copepods were found—one on the gills of a Siluroid, and the other attached at the junction of the pelvic fins of a Polypterus. Of worms, a few Oligochætes were collected and a considerable number of leeches.

In addition to these were some Turbellaria, and various endo-parasites—Cestoda, Trematoda, and Nematoda—principally from the gut of fishes. Among the Polyzoa is, at any rate, one form with horseshoe-shaped lophophore, which has not yet been described from Tanganyika. There is probably little of interest in the molluscs collected, as my work was confined to the comparatively shallow water. I was struck by the irregularity in the appearance of the Tanganyika medusa, or rather the uncertainty of finding it at any particular time or place. It is doubtless, like all such forms, driven to and fro by wind and currents, but it is curious that one may be a month or more on the lake without seeing a single specimen. I have brought back a few in formalin, for museum purposes, and others preserved with a view to the histology. Some quantity of sponge was collected, encrusting in every case submerged rocks or shells.

Apart from actual collecting, some observations of physical interest were made. Attempts were made, both on Nyasa and Tanganyika, to observe the seiche alterations in water-level, and at the south end of Tanganyika the actual level of the water was marked, with the view of affording some basis of comparison for the use of future investigators. A good many readings of the water temperature have been taken, which should prove interesting, as I believe nothing has ever been recorded from these lakes before. The temperature in general seems very high, the lowest obtained on the lake being only 73°·3, and the highest recorded 81°·0. At a depth of 76 fathoms (length of the sounding-line) the temperature appears fairly constant, for readings taken on various occasions, and at different spots, only vary between 74°·1 and 74°·8.

The total length of time spent on and around Tanganyika was about eight months. Dismissing the dau at Usumbura, at the north end of the lake, I began on March 18, 1905, the journey overland to the western shore of the Victoria Nyanza. This took rather longer than was expected, owing to the bad weather and the famine-stricken nature of the country, but Bukoba, a German station on Nyanza, was reached on April 16. During a stay of ten days waiting for the steamer, and during a short stay in Entebbe, the British capital, I was able to do some collecting in this lake also. As far as possible, representatives of the water flora were obtained, for the sake of comparison with the plants collected on Nyasa and Tanganyika. A few tow-nettings were taken, and, in addition to the smaller plants and animals thus obtained, there were also collected a few molluscs, some Argulus, and certain endo-parasites. More interesting was the finding of a species of prawn and a sponge, as no sponge had been recorded from the lake before.

[1] From a report by Mr. W. A. Cunnington, Christ's College, Cambridge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE council of King's College, London, has received a donation of 500*l*. from the Drapers' Company for the further equipment of the physics laboratory, especially for the promotion of research.

PROF. W. W. WATTS, F.R.S., assistant professor of geology and professor of geography at the Birmingham University, has been appointed professor of geology at the Royal College of Science, South Kensington, vacant by the retirement of Prof. J. W. Judd, C.B., F.R.S. In view of the changes in organisation that may be found desirable in the Royal College of Science and the Royal School of Mines after the consideration of the report of the departmental committee on the college, the appointment has been made a temporary one.

THE council of the Armstrong College of Durham University in Newcastle has resolved to found a chair of

electrical engineering, and has voted a sum of 260*l.* toward the equipment of electrical engineering laboratories. At the end of the current session two fellowships of 125*l.* a year will be offered for competition, on condition that the holders should spend their time in the prosecution of definite research or in the pursuance of a definite line of advanced study. Mr. H. Morris-Airey, lecturer and demonstrator in physics in the University of Manchester, has been appointed lecturer in physics at the college in succession to Mr. R. J. Patterson.

THE movement for extending higher education in the Potteries has received (says the *Lancet*) a great impetus from the offer by the Duke of Sutherland of Trentham Hall to the Staffordshire County Council for higher educational purposes. For some time a scheme to establish a university college for North Staffordshire has been energetically brought forward, and promises of help have been received from the North Staffordshire Institute of Mining and Mechanical Engineers, from a joint committee of china and earthenware manufacturers, and from various other sources. The scheme commended itself so much to the county council that it offered to contribute 12,500*l.* to the building fund, and to undertake the maintenance of the college. The hall is considered to be in every way admirably adapted for the purposes of a university college.

THE following gifts in aid of higher education have been announced in *Science*. The Pennsylvania College for Women in Pittsburg has succeeded in raising 38,000*l.* to pay off a mortgage resting upon its property, and to make a beginning in securing an endowment. After the mortgage has been paid, the college will possess as the nucleus of an endowment fund the sum of 25,000*l.* Mr. Andrew Carnegie has promised to contribute 10,000*l.* toward the endowment fund of Bates College when 20,000*l.* shall have been raised for the same purpose by friends of the college. The University of Pennsylvania received last month an anonymous gift of 10,000*l.* Lake Forest University has received 12,000l., and the University of Wisconsin a bequest of 2000*l.* by the will of the late Mrs. Fannie Parker Lewis, for the establishment of scholarships for needy young women students.

SIR PHILIP MAGNUS, the new Member of Parliament for the University of London, after the formal announcement of the result, proposed a vote of thanks to the Vice-Chancellor for the manner in which, as returning officer, he had conducted the election. During the course of his remarks, Sir Philip Magnus said that during the last two years he has served on a departmental committee presided over by Mr. Haldane to inquire into the working of the Royal College of Science and Royal School of Mines, in relation to other educational institutions. The report of the committee is settled, and Sir Philip Magnus said he was disclosing no secrets when he announced that, if effect is given to the recommendations, London will before long possess an institution, closely connected with the University, for the higher scientific training, and for the application of science to engineering in all its branches, which will compare favourably with any similar school in Europe or America.

AT the meeting of the Sociological Society on January 22, Prof. R. M. Wenley, of the University of Michigan, read a paper on sociology as an academic subject. Sociology, although taught in all the great universities of the United States, is academically in an experimental stage. Like other new subjects, it has received much criticism as being unsuitable for inclusion in the university curriculum. It is said to lack disciplinary value, and it is urged, moreover, that students come to it without the necessary basis in previous knowledge. Prof. Wenley attaches little importance to the first objection, but admits that the second is of real weight. Answering the question, What ought sociology to be as an academic subject? Dr. Wenley suggested that at Cambridge it might well form a part of the moral science tripos; at the Scottish universities, it might be attached to the *practical* training of the theological faculty; in London the opportunities for ethnological, linguistic, and economic research are in need of its complementary aid. Wherever ethics, psychology, economics, anthropology, or the various forms of ethnology have a place, sociology is needed as a coordinate discipline. The paper concluded by urging that sociology must be a science conducted by scientifically trained, competent experts, and not merely a pottering-round so-called problems of local or even national origin by well meaning enthusiasts.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"On the Distribution of Chlorides in Nerve Cells and Fibres." By Prof. A. B. **Macallum** and Miss M. L. **Menten**. Communicated by Prof. W. D. Halliburton, F.R.S.

At the present day, when numerous observers are seeking the explanation of certain nerve-phenomena on an electrolytic basis, it is imperative that accurate knowledge of the electrolytes present should be first obtained. Prof. Macallum has carried out previous work in this direction, and has discovered methods for detecting the inorganic salts microchemically. He has, among other things, found that nerve cells are destitute of potassium. This element, at any rate, is not revealed by tests which show its presence in other tissues, though it is possible, as Prof. J. S. Macdonald has pointed out, that it may be present in a "masked" form, from which it is liberated by injury. Another reaction at which Macallum has worked is the well known reduction stain with silver nitrate. The staining has been attributed by some histologists to the formation and subsequent reduction in sunlight of a silver-proteid compound. But this cannot be the case, because proteids freed from inorganic salts do not give the reaction. The test is shown to be entirely due to inorganic chlorides, and thus forms a method of great delicacy for the detection and localisation of chlorine in the tissues.

The present paper deals with the distribution of chlorine in the nerve-units. The chlorides present are probably numerous, but sodium chloride is the most abundant. By the ordinary method, nerve fibres exhibit the well known crosses of Ranvier. One limb of the cross is due to the presence of chlorides in the cementing substance which forms a ring at the junction of the neurilemmal elements. The other is due to staining of the axis cylinder itself; this usually exhibits itself, not as a continuous dark stain, but as a series of transverse striæ known as Frommann's lines. It is, however, shown that the same appearance can be produced by suitable modifications of manipulation at any portion of an axis cylinder, and that its greater intensity at the nodes is simply due to the fact that at these spots the reagent can penetrate more readily; the sheath of the fibre presents considerable impediment to the passage of the reagent inwards and of chlorides outwards.

The next question that arises is whether Frommann's lines indicate a definite preexisting arrangement of the chlorides in layers, or whether the appearance is an accident explicable on a physical basis. It is quite conclusively shown that the latter explanation is the correct one. The appearance can be most successfully imitated in capillary tubes filled with chromate-holding gelatin or white of egg, and is merely the result of physical processes, as Boehm and Liesegang were the first to point out.

Nerve cells also contain chlorides, but the intensity of the reaction is less, and is usually limited to the peripheral portions of the cell, principally because of the difficulty the reagent has of penetration. The nucleus, however, like other nuclei, is apparently free from chlorides.

The distribution of electrolytes such as sodium chloride in the colloid material of an axis cylinder would not permit ions carrying an electrical charge to travel unimpeded, and in consequence the change of potential transmitted would progress with diminished velocity. This diminution would bring into line as parallel phenomena the nerve impulse and the electrical current of action. It must, however, be freely admitted that caution should be shown in drawing conclusions of this kind where so much is still unknown.

Geological Society, January 4.—Dr. J. E. Marr, F.R.S., president, in the chair.—The highest Silurian rocks of the Ludlow district: Miss G. L. **Elles** and Miss I. L. **Slater.** The authors give a classification of the beds, and a brief outline description of the main subdivisions is first given, as they appear when followed from Ludlow southward to Overton, eastward to Caynham Camp, westward to Downton-on-the-Rock, and northward to Bromfield, and also near Onibury and Norton. The main tectonic features of the district appear to be due to the superposition of Armorican movements in rocks with a Caledonian trend, held by some rigid mass to the north, presumably the Longmynd massif.—The Carboniferous rocks at Rush (County Dublin): Dr. C. A. **Matley,** with an account of the faunal succession and correlation: Dr. A. **Vaughan.** Rocks of the Carboniferous Limestone series are exposed along five miles of coast near Rush, Loughshinny, and Skerries, in County Dublin. The present paper deals only with the beds near Rush, in the southern portion of this tract, where about 2500 feet of the series are exposed, without allowing for gaps in the succession. The upward sequence is (on the whole) from south to north, and the range is from the Upper Zaphrentis- to the Upper Dibunophyllum-zone.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—Experiments on the Chemical Behaviour of Argon and Helium: Dr. W. T. Cooke.—The Vapour Pressure in Equilibrium with Substances holding Varying Amounts of Moisture. Parts I. and II.: Prof. F. T. Trouton, F.R.S., and Miss B. Poole.—Note on Heusler's Magnetic Alloy of Manganese, Aluminium and Copper: Prof. A. Gray, F.R.S.—On the Overstraining of Iron by Tension and Compression: Dr. J. Muir.—On the Effect of High Temperature on Radium Emanation: W. Makower.—Observations and Photographs of Black and Grey Soap Films: H. Stansfield.—Galvanic Cells Produced by the Action of Light. The Chemical Statics and Dynamics of Reversible and Irreversible Systems under the Influence of Light. Second Communication: Dr. M. Wilderman.—Artificial Double Refraction due to Æolotropic Distribution, with Application to Colloidal Solution and Magnetic Fields: T. H. Havelock.—An Electrical Measuring Machine for Engineering Gauges and other Bodies: Dr. P. E. Shaw.—The Relation between the Osmotic Pressure and the Vapour Pressure of a Solution: W. Spens.—The Elliptic Integral in Electromagnetic Theory: Prof. A. G. Greenhill, F.R.S.—On the Simple Group of Order 25920: Prof. W. Burnside, F.R.S.—On Metallic Reflection and the Influence of the Layer of Transition: Prof. R. C. Maclaurin.

SOCIETY OF ARTS, at 8.—High Speed Electric Machinery, with Special Reference to Steam Turbine Machines: Prof. S. P. Thompson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering: F. W. Carter.

FRIDAY, JANUARY 26.

PHYSICAL SOCIETY, at 5.—The Isothermal Distillation of Nitrogen and Oxygen and of Argon and Oxygen: I. K. Inglis.—On the use of Chilled Cast Iron for Permanent Magnets: A. Campbell.—Experiments on the Propagation of Longitudinal Waves of Magnetic Flux along Iron Wires and Rods: Prof. T. R. Lyle and J. M. Baldwin.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Prince of Wales Pier, Falmouth: T. R. Grigson.—Ferro-Concrete Pier at Purfleet: H. O. H. Etheridge.

SATURDAY, JANUARY 27.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Methods of Fire-making, Ancient and Modern—A Lecture and Demonstration: Miller Christy.

MONDAY, JANUARY 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Functions of Certain Water Plants in Chile: Prof. G. F. Scott Elliot.

SOCIETY OF ARTS, at 8.—Modern Warships: Sir William White, K.C.B., F.R.S.

INSTITUTE OF ACTUARIES, at 5.—The Variations in Masculinity under Different Conditions: J. N. Lewis and Dr. C. J. Lewis.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION, at 5.—Impressions of Travel in China and the Far East: Prof. E. H. Parker.

SOCIETY OF ARTS, at 8.—The Chemistry of Artists' Colours in Relation to their Composition and Permanency: Prof. J. M. Thomson, F.R.S.

FARADAY SOCIETY, at 8.—The Electric Furnace: its Origin, Transformations and Applications. Part III.: Adolphe Minet.—Demonstration of a New Electrolytic Tube Furnace: Dr. J. A. Harker.—Note on the Production of Ozone by Electrolysis of Alkali Fluorides: E. B. R. Prideaux.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Railway-Gauges of India: F. R. Upcott.

WEDNESDAY, JANUARY 31.

ROYAL GEOGRAPHICAL SOCIETY (Research Department), at 5.—Suggestions as to an Inquiry into the Resources of the British Empire: Prof. G. F. Scott Elliot.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On the Filtration of Crystalloids and Colloids through Gelatin, with Special Reference to the Behaviour of Hæmolysins: J. A. Craw.—Chemical Action of *Bacillus lactis aerogenes* (Escherich) on Glucose and Mannitol. Production of 2:3-Butyleneglycol and Acetylmethylcarbinol: Dr. A. Harden and G. S. Walpole.—On Voges and Proskauer's Reaction for Certain Bacteria: Dr. A. Harden.—The Quantitative Estimation of Small Quantities of Nickel in Organic Substances: H. W. Armit and Dr. A. Harden.—The Alcoholic Ferment of Yeast Juice: Dr. A. Harden and W. J. Young.—On the Function of Silica in the Nutrition of Cereals. Part I.: A. D. Hall and C. G. T. Morison.

CHEMICAL SOCIETY, at 8.30.—Hydroxylamine-$\alpha\beta$-disulphonates (Structural Isomerides of Hydroxyamino-sulphates or Hydroxylamine-$\beta\beta$-disulphonates): T. Haga.—Studies in the Camphane Series. Part XXI. Benzenediazo-ψ-Semicarbazino-camphor and its Derivatives: M. O. Forster.—The Relation between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—(1) The Relation between Absorption Spectra and Chemical Constitution. Part II. The Quinones and α-Diketones; (2) The Relation between Absorption Spectra and Chemical Constitution. Part III. The Nitranilines and the Nitrophenols: E. C. C. Baly and A. W. Stewart.—The Action of Light on Benzylidenephenylhydrazine: F. D. Chattaway.—The Union of Chlorine and Hydrogen: D. L. Chapman and C. H. Burgess.—Note on the Molecular Weight of Adrenaline: G. Barger and A. J. Ewins.—The Critical Temperature and Value of ML/O of Some Carbon Compounds: J. Campbell Brown.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Destructor Bye-products: F. L. Watson.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean in H.M.S. *Sealark*: J. Stanley Gardiner.

SOCIETY OF ARTS, at 8.—Howard Lecture: High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

CONTENTS.

PAGE

THURSDAY, FEBRUARY 1, 1906.

THE PHILOSOPHIC FOUNDATIONS OF SCIENCE.

Science and Hypothesis. By Prof. H. Poincaré. Pp. xxvii + 244. (London: The Walter Scott Publishing Co., 1905.) Price 3*s.* 6*d.*

Wissenschaft und Hypothese. By Prof. H. Poincaré. Autorisierte deutsche Ausgabe. Translated by F. and L. Lindemann. Pp. xvi + 342. (Leipzig: Teubner, 1904.) Price 4.80 marks.

A SCIENTIFIC man, while actively engaged in work of research, must have faith in the solidity of the foundations on which he builds his reasoning in order to preserve the persistent patience which is necessary if his work is to be successful. Were he to doubt that there are laws which cannot be broken, were he to examine critically every brick in his foundation in order to discover some secret flaw which might endanger the safety of his edifice, he would become a philosopher, but as a man of science he would go to swell the ranks of the unemployed. Nevertheless, we must assign a proper place in the history of scientific thought to the spirit of scepticism which throws doubt on the premises, has no faith in the reasoning, and only grudgingly concedes the conclusions. If I have qualified the statement contained in the opening sentence and confined its application to the time a man is actively engaged in scientific work, it is because there are periods in every man's life when it is good for him to dig down to the bottom of his beliefs. Nor will the critical examination of axioms and definitions be without profit; for it will tend to loosen the ties of preconceived notions which keep men of science, like other mortals, in bondage.

The special difficulty of inquiring into the laws which form the basis of our scientific beliefs consists in the fact that it is apt to lead us round in a circle. When we have tried to formulate a law of nature, we often discover that we have only defined a scientific term. A superficial mind, satisfied with this discovery, would proclaim that all science resolves itself into definitions and conventions, but a closer examination exposes the shallowness of such a conclusion. If among a number of possible definitions we choose a particular one, there must be a deeper meaning in the propriety of the choice. Even though a law may be of our own making, to use Prof. Poincaré's descriptive language, "our decrees are those of an absolute but wise ruler who consults his Council of State." The inquiry into a law of nature resolves itself, therefore, into an inquiry why that particular law is more convenient than others that can be imagined, but this conclusion only brings us back to our starting point, the question as to the truth of a law and its convenience being identical.

Prof. Poincaré's volume will come as a revelation to many who have thought but little about these matters, and as a relief to others who have attempted without success to arrive unaided at a conclusion satisfactory to themselves. But the book requires close and careful study, and a superficial gleaning of its contents would probably lead to mental disaster. For, even following Prof. Poincaré's guidance, we feel ourselves all the time walking along a precipice, at the bottom of which is written, "You shall never know anything of the real construction of the material universe." The author seems to enjoy taking us very near the edge of that pit, and when he whispers into our ears, "what you cannot know is not worth knowing," we feel as if he intended to throw us over. But he has a sense of humour which saves him and us, and there is always a solution which we should perhaps have rejected at first sight, but which we are glad to accept after a contemplation of the less cheerful alternatives which have been brought into our view. There is certainly no one with the same intimate knowledge of mathematical and physical science who could have written with the same authority and produced a volume in which so much charm and originality are condensed. The wealth of his store of illustration is boundless, and the stringency of his logic leaves us without answer. Even in cases when our instincts rebel, we are carried away by the fascination of the language, which in each subdivision of the subject takes us with dramatic power to its artistic *dénouement*.

Could and should such a book be translated? The fascination of the original can certainly never be reached, but translation is allowable where the main argument can be reproduced without loss of clearness, though the delicacies of meaning to which the French language peculiarly adapts itself will undoubtedly be lost.

The English translation errs, perhaps, on the side of following too literally every sentence, and sometimes even every word in the sentences, of the French original. The meaning of the text is carefully though often awkwardly preserved. While the reader is not carried away by the incisive character of expression which belongs to the original, he will in most cases be able to re-construct the dominant idea. The German translation is more successful. We must ascribe this in the first place to the fact that one of the translators has himself made important contributions to certain parts of the subject, and, feeling himself secure in apprehending the meaning, has been able to reproduce the sense without putting any strain on the language. The result is that, while no one could read a few pages of the English edition without recognising the fact that it is a translation, the German carries with it much more of the freshness of an original book. The German translator is also to be commended for the addition of a good index. A series of notes is added, which take up a considerable fraction of the whole volume. Many of these notes will be useful, as they supply references to writings where the readers can study in greater detail important points on which Prof. Poincaré only touches with a passing allusion. But I cannot refrain from criticising the introduction of controversial matter. Differences of opinion between Sophus Lie and Prof. Lindeman are surely out of place in the translation of a book of this nature.

It is time to refer more particularly to the contents of the book. The volume opens with a chapter on the nature of mathematical reasoning, which is shown to be contained in a power of generalisation dependent on recurrent reasoning. When we have proved a theorem for one number, and show that if true for any number a, it is also true for a number $a+1$, we may assert it to be true for *all* numbers. This is the generalisation which, according to Poincaré, lies at the bottom of all mathematical argument, and allows us to pass from the finite to the infinite. The second chapter brings mathematical quantities into relationship with experiment, and treats, among other things, of incommensurable quantities and the creation of the physical and mathematical continuum. We are made to understand how, adopting a certain definition of a line which would satisfy most of us, the diagonal and inscribed circle of a square have no point in common, and we are then asked to admit the possibility of a curve which has no tangent. But a greater surprise is in store for us in the second portion of the book, where, in the course of an admirable discussion of the geometries of Lowatchewski and Riemann, we are introduced to the possibility of a fourth geometry, in which a right line may be at right angles to itself. This part of the book will probably be the one most valued by the student of experimental science, because it deals with an aspect of the subject which, though foreign to his customary plane of thought, must be of the highest interest if he desires to dip a little below the surface.

The conception of space and the relation of geometry to experiment are discussed briefly, but with great precision and clearness. The foundations of geometry are shown to be experimental. "If there were no solid bodies in nature, there would be no geometry." Yet, though founded on experiment, the laws of Euclidean geometry can never be upset by experiment:

"If, then, to contemplate the impossible, one were to discover negative parallaxes, or to find that all parallaxes lie above a certain limit, one would have the choice between two conclusions: We might reject the Euclidean geometry or, on the other hand, we might modify the laws of optics by admitting that light is not accurately propagated in straight lines. It is unnecessary to add that everybody would choose the latter alternative as most convenient."

The final conclusion is that "geometry is not true: it is convenient."

More than one-third of the book having been taken up with the discussion of the fundamental notions of mathematics, we are fully equipped to enter into the discussions of the laws more particularly associated with physics. All those who care to think of these matters at all must have given some attention to the nature of the so-called laws of motion. They will find much in Prof. Poincaré's reflections that has been familiar to them, and something, perhaps, that they have vaguely felt, but not been able to put into definite form. One point which is brought out clearly, which, speaking for myself, I had not sufficiently realised, consists in the difficulty of finding independent measures of both force and mass unless the third law of motion is treated as an axiom. The discussion of the third law will be found to be full of interest. Too little importance, perhaps, is attached to what the author calls "anthropomorphic mechanics." This is surprising, as anthropomorphic ideas are used by him so freely and convincingly in his foundation of geometrical laws. It is true enough that no one has yet been able to find a scientific basis of mechanics in an anthropomorphic conception of force, but at the same time I do not believe that anyone has ever truly reasoned about force without such idea forming the real moving spring of his thoughts. "One could not maintain," Prof. Poincaré says, "that the sun is conscious of a muscular effort when he attracts the earth." That is true enough, but we are able in our imagination to attach the idea of muscular effort to every effect of force in the same way as we can feel sympathetic pain for a friend who lies on the operating table, though our reason tells us that he himself is quite unconscious of pain. In that case we project our own sensitive and conscious mind into his unsensitive body, and to some extent feel the operator's knife. There are probably great differences in the way different brains work, but I could not myself form an idea of the mechanics of the solar system without imagining myself at its centre and consciously pulling the planets towards me. In the same way, if I imagine myself freely placed in space, I at once become conscious of a pull towards the sun. That anthropomorphism has played an important part in the history of mechanics is admitted by the author, but he restricts the philosophy of science to the discussion of the symbols which can be reduced to measurement.

Prof. Poincaré's discussion of the principles of the conservation of energy will be read with interest. That principle has been abused by energy specialists in a manner which could not fail to call forth a wholesome reaction. The weak point which Prof. Poincaré specially exposes seems, however, to me to touch not so much the enunciation of the principle as the difficulty of identifying potential and kinetic energies in cases where the mechanism of the phenomena is unknown to us. This only means that science is not sufficiently advanced to specify completely the different forms of energy. This most of us admit, while the Energetiker deliberately uses the principle of energy for the purpose of hiding his ignorance. Thermodynamics is briefly dwelt upon, but we should have liked to hear more of the author's views on the dissipation of energy. The far-reaching consequences of the gradual decay of regular motion assign to the second law of thermodynamics a predominant place, and put the importance of the first law completely into shade. Lord Kelvin's principle of dissipation of energy has opened out a common ground lying on the borderland between physics and metaphysics which has not been cultivated so much as it deserves to be.

It is not possible to follow Prof. Poincaré in his discussions of selected questions of modern theories of physics. They will be read with interest, though

many of us will not agree that "a day will come when the ether will be rejected as useless."

The reader will place the book—if possible the original, but *faute de mieux* its translation—on his shelves with the intention of frequently spending an instructive quarter of an hour with it. Each time he carries out his intention he will realise more the truth of the author's remark: "To doubt everything or to believe everything are equally convenient solutions: both absolve us from the necessity of thinking."

Arthur Schuster.

THE INTELLIGENCE OF ANIMALS.

Comparative Studies in the Psychology of Ants and of Higher Animals. By E. Wassmann, S.J. Pp. x+200. (St. Louis, Mo., and Freiburg: B. Herder; London: Sands and Co., 1905.) Price 4*s.* 6*d.* net.

AMONG those who have most carefully and successfully studied the habits and psychology of ants, Father Wassmann occupies a place in the front rank. He has especially devoted his attention to the curious and complicated relations which exist between ants and their domestic animals. Of these, he gives a list comprising no less than 1246 species! Father Wassmann is an accurate and careful observer, and his writings are most interesting.

To show how conscientiously he has studied the ants of his own district I may mention that he made a census of the ants' nests round his home. Many communities have more than one nest. Of *Formica sanguinea*, which he regards as the most gifted of European ants, he records 2000 nests belonging to 410 communities! Most of them have separate summer and winter nests, or rather nests for warm and dry, or cold and wet seasons.

Father Wassmann is by no means one of those who regard ants as exquisite automatons, "devoid even of the simplest sensitive perception and cognition." I quite concur with him—indeed, I expressed the same opinion nearly fifty years ago that "the life of ants is the climax of development in instinctive life throughout the animal kingdom"; and that "the chasm between the psychic life of animals and that of man, is, in many respects, wider between ape and man, than between ant and man."

Father Wassmann is also, I believe, quite correct in alleging that Buechner and Brehm, and even Romanes, have accepted many statements implying intelligence on the part of animals for which there was no sufficient evidence, some of which, indeed, were quite absurd; and, secondly, that they have in some cases built upon them conclusions for which there is no foundation, and which will not stand the test of critical examination.

On the other hand, I am unable to follow him when he altogether denies to ants any, even the most exiguous, rudiments of intelligence. As in the cases of Darwin and Forel, the conclusion forced upon me has been that animals, and especially ants, do possess some elements of intelligence. In that we agree with the vast majority of those who have studied dogs, elephants, &c.

Father Wassmann defines intelligence as "the power of acting with deliberation and self-consciousness, of inventing new means for attaining various purposes and thus making progress in civilisation." But if ants are descended from an original common stock in bygone times, no one will deny that they have "invented new means for attaining various purposes and thus making progress in civilisation." Moreover, even now we see them adapting themselves to the circumstances of their complex life in a manner which it is surely an abuse of terms to call "instinctive." He admits that the observations of all who have studied ants conclusively demonstrate that ants are not mere reflex machines, but beings endowed with sensitive cognition and appetite, and with the power of employing in the most various manner their innate, instinctive faculties and abilities under the influence of different sense-perceptions. Surely, then, under his definition it is impossible to deny that they have some intelligence.

For instance, in constructing their nests, as Father Wassmann admits, ants do not "cooperate with the regularity of a machine or according to a rigid pattern, but each ant with evident liberty follows her own impulse and her own plan. . . ."

"As a rule the most zealous and skilful worker is imitated most; her zeal is catching, so that she directs the activity of the others into the same channel."

Indeed, Father Wassmann's fairness and love of truth compel him to make several candid admissions which seem fatal to his position. For instance, an Algerian ant (*Myrmecocystus altisquamis*) has wide open entrances to the nest. A colony, however, which Forel brought to Switzerland, being much annoyed by the attacks of *Tetramorium caespitum*, gradually contracted the doorways. On this Father Wassmann admits that, "as Forel says, these facts afford irrefutable evidence of the great plasticity of ant instinct. For, this instinct is not merely a nervous mechanism forced to operate along uniform lines; it includes sensitive cognition and appetite, which are not only of an organic but also of a psychic nature."

Again, "within these limits, however, we find a wonderful adaptation of means to the end, and at times a marvellous sagacity of animal instinct, which appears nowhere else to such advantage."

"This phenomenon manifests the marvellous sagacity and quasi-intelligent plasticity of animal instinct, which can hardly be styled 'automatism.' Neither can it be identified with intelligence properly so-called, for this would suppose rational knowledge of the internal laws governing the growth of the ant organism, a knowledge far surpassing even the intelligence of man and entirely beyond the reflections and experience of ants."

Surely, however, if ants have sagacity they must have intelligence. Nor is the attribution to them of "sagacity" an isolated case. Again on p. 157 he says:—

"Their sagacity is instinctive, essentially different from intelligence and reflection. Ants are in their every action guided directly by sensitive perceptions, not by intellectual ideas. The enigma, therefore, is

satisfactorily explained by the innate adaptation of their sensitive cognition and appetite, whereas the hypothesis of animal intelligence is unable to offer any solution."

"Instinctive sagacity" seems to me, I confess, a contradiction in terms.

I admit that the subject is one of much difficulty, but if an ant applied Father Wassmann's rigorous criticism to man himself, I am not sure that our boasted gift of reason could be absolutely proved.

No doubt animals do stupid things, but so do we.

Father Wassmann describes what he justly calls the "lovely scenes" in an ant's nest—the care of the young, the "motherly tenderness" shown to the delicate pupæ—but denies that this is any evidence of affection, and contrasts it with the love of a woman or a man for their children. This, he maintains, "is a *rational* love, *conscious of duty* (the italics are his), therefore it is the highest and noblest love existing in Nature." Far be it from me to say a word against either reason or duty. They are amongst the highest qualities of our nature; but surely they have nothing to do with the love we feel for our children, which rests on even nobler feelings.

While fully recognising, then, the accuracy and interest of Father Wassmann's observations, and after carefully considering his arguments, I cannot but recognise in animals some vestiges and glimmerings of intelligence, and maintain, as I did thirty years ago, that "when we see an ant-hill, tenanted by thousands of industrious inhabitants, excavating chambers, forming tunnels, making roads, guarding their home, gathering food, feeding the young, tending their domestic animals—each one fulfilling its duties industriously, and without confusion—it is difficult altogether to deny to them the gift of reason; and the preceding observations tend to confirm the opinion that their mental powers differ from those of men, not so much in kind as in degree."

AVEBURY.

MAXWELL'S THEORY OF LIGHT.

The Electromagnetic Theory of Light. By Dr. C. E. Curry. Part i. Pp. xv+400. (London: Macmillan and Co., Ltd., 1905.) Price *12s.* net.

DR. CURRY bases his work, which is almost entirely analytical, on Maxwell's equations of the electromagnetic field. These equations suffice to account for the phenomena of electromagnetism, and the book is a discussion of the properties of electromagnetic waves in which the condition that the wavelength is short is generally, but by no means always, introduced. In these equations four vectors are concerned, the electric and magnetic forces, and the electric and magnetic displacements, or, as Dr. Curry prefers to call them, the electric and magnetic moments. The type of equation satisfied by each of these vectors is the same, and it is not necessary for Dr. Curry's purpose to identify the light vector definitely with either. It is another vector satisfying an equation of the same type.

No attempt is made to give a mechanical account of the properties of the ether; it is a medium in which transverse waves of electric and magnetic force are propagated according to the laws indicated by Maxwell's equations; in a crystal, however, of course the direction of the electric force does not lie in the wave-front; the same is true of the magnetic force if the permeability be a function of the direction.

Working on these lines, Dr. Curry has put together a large amount of information as to the analytical properties of such waves. The earlier chapters are entirely taken up with the discussion of the forms defined by certain particular solutions of the equations of motion, for if $\phi \equiv f(r \pm vt)/r$ be a solution, so is $d^n\phi/dx^\lambda dy^\mu dz^\nu$, where $n = \lambda + \mu + \nu$. Some of the solutions thus obtained are of importance in the theory of light, but, as the author states, their interest is chiefly theoretical; and one of his "chief reasons for the elaborate treatment of this particular class of waves has been to indicate another fertile field of research offered by Maxwell's equations."

In chapter iv. we are introduced to the phenomena of interference, treated at first in a simple manner, but applied later to the various kinds of waves the properties of which have already been discussed. The more usual problems of optics first become prominent in chapter v., which deals in the ordinary way with Huyghens's principle and its application to the rectilinear propagation of light. The first difficulty occurs in the attempt to find an expression for the secondary disturbance transmitted from a given element of a primary wave. Such expression may clearly involve the angle ϕ between the normal to the wave and the direction in which the secondary disturbance is being estimated, but the statement that "it is natural to assume that the law of variation of the light vector . . . be according to the cosine of the obliquity of the angle ϕ" is not very convincing, and there seems no reason for calling this law the "natural law of obliquity." The law is, of course, a simple one, and it allows of the analytical solution of various problems which are hardly tractable when a more complex law is assumed; but this is its sole merit. Stokes showed that the true factor is $(1 + \cos \phi)$, and this law is utilised later on; but the physical reason for the change of phase in consequence of which the secondary disturbance from a wave $\sin k(vt - r)$ becomes proportional to $\cos k(vt - r)$ is not discussed as fully as its importance deserves. On these points, reference might with advantage have been made to Prof. Schuster's article in the *Philosophical Magazine*, vol. xxxi.—it is quoted later on another point—or to Lord Rayleigh's article in the "Encyclopædia Britannica." Following this a rigorous proof of Huyghens's principle is given in the usual way from the consideration of the relations existing between certain volume and surface integrals, and the result is applied to optical problems; but the fact that this rigorous analysis leads to Stokes's law of obliquity is not definitely stated, though it follows at once from the formulæ on p. 176.

Diffraction phenomena are explained by the use of the same principles, employing the most general formula for the secondary disturbance, and assuming

that the disturbance is zero over the opaque portion of the diffracting screen, while over the transparent portion it has the same value as though the screen were absent. The results are applied to the problem of diffraction by a straight edge leading to Fresnel's integrals and the properties of Cornu's spiral. These might have been obtained more simply, though the rigorous method has its advantages in enabling one to see the meaning of the various simplifications introduced in the process. Later on in the discussion an interesting account of Sommerfeld's theory is given.

The latter part of the book is taken up with the usual theory of reflection and refraction and of double refraction. The surface conditions are deduced from the electromagnetic equations, and the relations between the incident reflected and refracted vectors follow readily. Attention is directed to the fact that the laws thus deduced do not hold for light, and the effect of a transition layer is considered in a satisfactory manner.

In the last chapter we have the equations relating to the propagation, reflection, and refraction of electromagnetic waves by crystals.

At present, part i. only of the whole treatise is under consideration. This deals, as will have been observed, with the analytical portions of the subject for which Maxwell's theory gives a satisfactory explanation. In part ii. the author hopes to consider the really more interesting portions where the simple Maxwell theory needs modifications before it will fit the facts. Readers will await with interest Dr. Curry's treatment of the phenomena of the rotation of the plane of polarisation, absorption, metallic reflection, the Zeeman effect, and the relations generally between magnetism and light.

INDIAN HERMIT CRABS.

Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum. Part ii., *Anomura.* Fasciculus i., *Pagurides.* By A. Alcock, M.B., LL.D., F.R.S., C.I.E. (Calcutta: Indian Museum, 1905.) Price 14 rupees.

THE second instalment of Dr. Alcock's fine "Catalogue of the Indian Decapod Crustacea" is now before us. It deals with the hermit crabs (Paguridea or Pagurides), and forms the first fascicule of the second part, which is devoted to the Anomura. Dr. Alcock is thus making use of the old classification of the Decapoda into Brachyura, Anomura, and Macrura, a course to which modern opinion seems to incline—and, as we think, rightly—in spite of the many merits of Boas's arrangement of the group under the suborders Reptantia and Natantia. In the hands of different authors, the limits of the Anomura have varied considerably, and Dr. Alcock takes the term in the sense of Boas's Anomura, including under it the Paguridea, Galatheidea, and Hippidea only. Now there can be no question that Boas was right in excluding the sponge crabs (Dromiacea) and sand crabs (Oxystomata) from the Anomura when he formed his tribe Anomala, but we believe that the group thus constituted is still an imperfect one, in that it is not true to genealogy, since it omits the Thalassinidea, which are certainly more nearly akin to the primitive hermit crabs than they are to the lobsters, near which they are generally placed. This is not denied by Dr. Alcock, but he gives as his reason for taking the old course with the Thalassinidea that to include them with the Anomura "is going too far, as being likely to confuse the systematist"—a poor compliment to the systematist! A zoological classification must be one of two things—either purely empirical, or based on genealogical facts so far as we can ascertain them, though no one is likely to choose the former alternative at this time of day—but in either case illogical concessions to supposed infirmities of the human intellect do not seem to us to be admissible. However, authorities will never agree on questions of classification, and we do not regard the author's decision as a serious blemish on this otherwise wholly admirable work.

In this volume, as in that on the Indian crabs, Dr. Alcock starts with an introduction on the group as a whole, in which he has condensed into a few pages a great deal of very interesting and useful information. In the tables of distribution which follow it appears that the littoral forms are generally Indo-Pacific in range, but that the more primitive sublittoral genera have a very distinct circumtropical distribution. The bearing of this fact on geographical problems is, of course, an important one. The bulk of the work is taken up with systematic descriptions, which are as excellent as is all Dr. Alcock's work in this line, and deal with some ninety species of twenty-eight genera. At the end of the volume is a "table of the genera and species of Pagurides," with bibliographical references, which must have been extremely laborious to compile, but will now be correspondingly helpful to systematists. The illustrations are excellent.

L. A. B.

OUR BOOK SHELF.

Traditions of the Caddo. Collected under the auspices of the Carnegie Institution of Washington by George A. Dorsey, Curator of Anthropology, Field Columbian Museum. Pp. 136. (Washington, D.C.: Carnegie Institution, 1905.)

The make-up of this volume is somewhat curious. It contains one hundred and one pages of texts, followed by twenty-eight pages of abstracts of the same in small type; there is no index, and the only notes are almost monosyllabic, for they merely indicate by whom the story was told—a fact of little value, inasmuch as we learn absolutely nothing of the narrator beyond his (or her) name. This is the more regrettable, as the Caddo, a tribe allied to the Pawnee and Arikara and associated more especially with the Wichita, has retained none of its ancient culture, and we must therefore know the history of the tribe and of the individual narrators before we can judge of the influences that have gone to shape their stock of folk-tales. Equally regrettable is the absence of notes on the stories themselves; it is true that native names are translated, but there are many points on which the editor could throw light with advantage; for example, in tale 35 we find a dead man cannot get into Spirit Land because he cannot fit his arrows to his bow-string, which has a knot in it; a living man puts in

a new bow-string; the ghost shoots arrows in the air and goes up with them.

For those who are interested in these *märchen*, less for the light they may throw on the problem of diffusion than for the evidence they contain of the beliefs and customs of the Caddo, the usefulness of the work is diminished both by the absence of notes and the lack of an index. For European readers, at any rate, there is a further desideratum, viz. some account of the tribe the tales of which are here collected; the American Folklore Society has set a good example in this respect in the volume of Skide Pawnee tales.

The seventy tales in the present volume, which is to be followed by others on the allied tribes, are largely concerned with the adventures of Coyote and other animals. The first ten are either cosmogonic or deal with origins of various kinds; we have the familiar story of the way in which death was introduced into the world, in this case by Coyote; the deluge legend is probably late, as the flood is sent as a punishment; in a parallel story the destructive animals, which lived at the beginning of the world, are destroyed by fire, mankind being saved by climbing up a rope made on earth and made fast to the sky by Crow. More familiar is the tale of the hare and the tortoise, here told by Coyote and Turtle; in these tales the distinguishing characteristic of the former is his stupidity.

Meccanica Razionale. By Roberto Marcolongo. Vol. i., Kinematics—Statics, pp. xii + 270; vol. ii., Dynamics—Principles of Hydromechanics, pp. vi + 126. (Milan: Ulrico Hoepli, 1905.) Price 3 lire each volume.

No better proof could be adduced of the general and popular interest taken in higher mathematics in countries outside Great Britain than the excellent series of manuals emanating from the firm of Hoepli in Milan. One great difficulty in acquiring a *general* knowledge of such subjects as analytical statics, particle and rigid dynamics, and hydrodynamics arises from the voluminous character of the principal treatises available as text-books. Most of the English standard works on such subjects were originally smallish single volumes, but they have in the course of various editions grown in size until they have reached to two large and bulky volumes. Anyone who can read Italian can now, at a cost of five shillings, obtain in Prof. Marcolongo's two little manuals a survey of such subjects as vector analysis, polhodes and herpolhodes, the ordinary and spherical catenary, planetary motion, Lagrange's equations, the theory of least action, cycloidal and compound pendulums, attractions of ellipsoids, Lagrange's and Euler's equations of hydrodynamics, and the principles of vortex motion.

Die Vererbungslehre in der Biologie. By Dr. H. E. Ziegler. Pp. 74; with 59 figures in the text and 2 plates. (Jena: Gustav Fischer, 1905.)

THIS little work represents a fairly successful effort to put in simple language the complex problems of heredity so far as they have yet been analysed. The author discusses the evidence that cytology has been able to furnish in connection with the theories of variation, and he especially deals with the views of Weismann and of De Vries as to the meaning of variation as expressed in terms of the cell. His attitude towards the mutation theory of De Vries is rendered clear by the following sentence from p. 69, "Wenn man nicht auf dem Standpunkt der 'intracellularen Pangenesis' steht, so kann man nicht einsehen, warum zwischen kleinen und grossen Abänderungen, also zwischen allmählicher und stossweiser Veränderung, eine strenge grenze gezogen werden soll." But the question here raised is not one dependent on theory or hypothesis; it is a question of fact, and the existence of opposite opinions merely demands a more thorough investigation at the hands of persons unbiased by prejudice. Perhaps, as was formerly the case with the inheritance of the so-called "acquired characters," much of the prevalent opposition to the theory of mutation rests on a misunderstanding of the main idea embodied in the word itself.

An Analysis of Human Motive. By F. Carrel. Pp. viii + 222. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1905.) Price 5s. net.

THIS volume discusses the six predominant motives which influence man, viz., those of sustenance, sex, pleasure, sympathy, self-love, and religion; examines slightly the conflicts of motives, the relation of motives to moral systems, and the like; and sums up the matter in a series of conclusions which is not entirely destitute of merit.

But the work as a whole is disappointing. The sentences are lumbering and long, sometimes twelve lines long; there are no indications that the author has read very widely, nor is any remarkable insight displayed. Felicitous illustration would have lightened many a page; but of illustration there is almost nothing. The obvious has no terrors for our author, and so the satirical rogue frequently indulges in slanders like the following:—"The pleasure motive may lead persons to pass time in witnessing theatrical performances, and when the taste has been formed and the habit acquired, to spend more of their resources upon such amusements than their means justify." Split infinitives and the use of "practise" as a noun do not lead one to rank the writer as an authority on English. One statement seems defective in mathematical accuracy:—"In provincial towns the proportion of men to women (among church-goers) is twelve to a hundred. In London the proportion is *two-thirds women to one-half men.*" It is difficult to avoid seeing a *non sequitur* in the following:—"The grief experienced at the death of a beloved relative cannot be long continued without interfering with the normal course of life and coming into conflict with its essential motives, and therefore we see that the violent acts of despair to which it tends, are not resorted to as long as the mind has not completely lost its rationality."

We gather that the author thinks much of Epicurus and of Spencer, but little of Aristotle's "Nicomachean Morals," which are, it would seem, of little more than historical interest. The writer continues:—"It was their want of precision that enabled them to be adopted by the schoolmen of the middle ages, as a basis for their ethical dialectics." That Aristotle and this author have very different views of what constitutes precision is true and obvious, but not a circumstance on which this author is to be congratulated.

Deutscher Kamera Almanach, 1906. Second year. Jahrbuch der Amateur-Photographie. By Fritz Loescher. Pp. viii + 280. (Berlin: Gustav Schmidt, 1905.) Price 3.50 marks.

THIS is the second issue of this annual, and from its appearance it seems to be very hardy. The first-named title does not seem very befitting to the volume before us, as the "Almanack" portion is more conspicuous by its absence than presence. As a "Year Book" containing an excellent series of well written articles on numerous photographic subjects by recognised workers in Germany, England, France, &c.; novelties of the year; progress; exhibitions; list of German amateur photographers' societies; most important recent photographic literature, and other useful information, the book will be found of interest to those who are able to read German. The illustrations are good and numerous, and include a frontispiece, 47 full page pictures, and 107 others distributed throughout the text.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Fresnel's Theory of Double Refraction.

THERE is a point in connection with the ordinary expositions of Fresnel's theory of double refraction to which, on account of its frequent occurrence, it is perhaps worth while to direct attention. It is found in Aldis's "Tract on Double Refraction," p. 7, in Preston's "Theory of Light," third edition, p. 328, and in Basset's "Treatise on Physical Optics," p. 115.

Having shown that when a molecule receives a displacement ρ, the other molecules of the system remaining fixed, the restoring force along the line of displacement is $F=\rho/r^2$, where r is the parallel radius-vector of a certain quadric, Preston, for instance, proceeds as follows:—"Hence, if we consider only the component F as effective, the equation of motion of the particle will be

$$d^2\rho/dt^2 = -\rho/r^2 \quad \ldots\ldots \quad (10),$$

and the time of vibration will consequently be given by the equation

$$T = 2\pi r \quad \ldots\ldots\ldots \quad (11).$$

But the velocity of propagation is connected with the wavelength and the periodic time, by the equation $\lambda = vT$, therefore

$$v = \lambda/2\pi r \quad \ldots\ldots\ldots \quad (12)."$$

Now if equation (10) refer to the motion of a particle when the others remain fixed, there is no question of a wave at all, and the deduction of a propagational speed is without meaning; if, on the other hand, we are to regard (10) as giving the motion of a particle in the front of a luminous wave, then equation (11) expresses the bizarre result that the frequency, that is the colour, of the light is dependent upon the direction of vibration.

Fresnel's method was quite different; having determined the value of the restoring force on the supposition of absolute displacements, he employed it for the case of relative displacements, and regarding the component parallel to the wave as alone effective, he *assumed*, on the analogy of the transversal vibrations of a stretched string, that the propagational speed is proportional to the square root of the effective force. Hence, taking the azis of z in the direction of propagation, and making a suitable choice of the unit of mass, we should have in place of (10)

$$\partial^2\rho/\partial t^2 = 1/r^2 \; \partial^2\rho/\partial z^2,$$

giving in place of (12) $v = 1/r$.

One other point may be mentioned. Preston and Basset, quoting from Verdet, state that one of the hypotheses on which Fresnel founded his theory is that the vibrations of polarised light are at right-angles to the plane of polarisation. This is not strictly correct. There is no doubt that this assumption played its part among the ideas that led Fresnel to formulate his theory: in the theory, however, as finally presented, it does not appear as a fundamental hypothesis; it follows, in fact, as a direct *consequence*. On the other hand, the postulate that the ether is incompressible should be included among the hypotheses of Fresnel; indeed, if this be not assumed, the effective component of the force of restitution would have, as Sir G. Stokes has pointed out ("Math. and Phys. Papers," iv., 158), a value quite different from that given by Fresnel.

JAMES WALKER.

Oxford, January 19.

On an Alleged New Monkey from the Cameroons.

I MUCH regret that in describing, in NATURE for October 26 last, the monkey on which I bestowed the name *Cercopithecus crossi*, I overlooked the description of *C. preussi* by Matschie. Dr. Lönnberg, of Stockholm, was kind enough to write me early in November to say that he had "a strong suspicion that your guenon may prove identical with *C. preussi*," described in *Sitz. Ber. Naturforsch. Freunde Berlin* in 1898. Only last week, however, was I able to consult this volume, and there is no doubt that, as Mr. Pocock has now also pointed out, Matschie's name has priority over *C. crossi*.

HENRY O. FORBES.

The Museums, Liverpool, January 27.

FORESTS AND RIVERS.

AT the recent meeting of the International Navigation Congress at Milan, one of the questions taken into consideration was "the influence which the destruction of forests and desiccation of marshes has upon the *régime* and discharge of rivers," and seven papers bearing on the subject were read and discussed. Of these, three were from Austria, and the others from Germany, France, and Russia. The problem as to the effect of forests on the water supply of rivers and on climate is of great social importance on account of the agricultural and commercial interests which are so closely connected with the use of timber, and with the utilisation of running water.

It is allowed by all the authors of these papers that, due to the improvident way in which the forests have been dealt with, there has been a marked change in the water supply of the neighbouring rivers; that where forests have been cut down brooks have disappeared, and many small rivers that at one time were useful as sources of power are so no longer for want of water; that in the larger rivers torrents have become more impetuous, and flooding more frequent; while, on the other hand, navigation suffers at times for want of water.

The greatest harm has been done in the mountain districts, where the steep slopes allow the rain-water to run off too rapidly, carrying away the surface soil and transporting pebbles and boulders into the rivers, causing shoals, and thus decreasing their capacity to discharge the flood water.

The extent to which forests, both on the Continent and in America, are being cut down and destroyed, and large areas of land, which at one time were covered with primæval forest, have become barren waste by fire or the lumberman's axe without any attempt at re-afforestation, was one of the subjects dealt with in the presidential address of Mr. J. C. Hawkshaw at the Institution of Civil Engineers in 1902. Mr. Hawkshaw pointed out that, notwithstanding the displacement of wood in building structures by iron, yet large quantities of timber are still required, not only for building purposes, but for temporary structures, such as coffer dams and scaffolding; pit props for mining; sleepers required for the railways, which, in this country, he estimated at an annual value of 18 million pounds, and those required for renewals at three-quarters of a million pounds; while for the railway service of the United States there are required 15 millions of acres of forest land to maintain a supply of sleepers.

The question for consideration at the Congress was whether the wholesale destruction of forest land for cultivation or for timber supply is having any material effect on the rainfall and consequent water supply; and the effect of forest destruction on the rivers of the country from which the trees are removed was also considered.

The physical conditions of forest land are that, owing to the shelter from sun and wind, the atmosphere is generally colder and damper than in the open country, and evaporation consequently less. It is calculated that a hectare of forest land ($2\frac{1}{2}$ acres) gives off every day 37 cubic metres of oxygen and 37 metres of carbonic acid, leading to a great expenditure of heat; and that from every hectare of forest land sufficient heat is abstracted to melt 316 cubic metres of ice. Ligneous plants also withdraw from the ground and discharge as vapour more than 40,000 gallons of water per hectare per day, which causes a sensible reduction of temperature. When clouds pass over a forest they encounter a cool, damp atmosphere, the point of saturation comes closer, and

rain is caused. This condition of forest land has been remarked on by aëronauts, who find that a balloon is invariably affected, and drops when passing over forests.

The advantages claimed for forests with regard to water supply are that the trees act as regulators of the rainfall; that the average quantity of rain falling on land covered with forests is greater than in the open ground to the extent of about one-sixth; that it holds up the water for a time and discharges it later on when water is most required in river basins, the rain being held back by the leaves of the trees and coming to the ground more gradually; the rain that falls on the surface is also taken up by the layer of dead leaves on the ground, which permits of a gradual percolation to the subsoil. Observations show that in summer the ground of the forest is damper than that of the adjacent cleared land, and snow remains for a much longer period in forest land before melting than in cleared land.

On the other hand, it has been contended by some of those who have made a study of sylviculture that forests do not increase the quantity of water flowing to the springs and rivers, but reduce it. The numerous striking facts quoted do not bear out this contention, which is mainly based on the fact that the substratum water stands at a lower level on forest land than in the adjacent cleared ground. This fact is generally admitted to be the case at one period of the year. As the result of many years' observations, it has been found that the maximum level of underground water is reached in May, that the water accumulates in the ground from August to January; and that the rivers are supplied by this reserve, and were it not for this accumulation many brooks and river feeders would cease to flow in summer.

Several very striking examples are given by the authors of the papers as to the deleterious effect of cutting down forests, especially in hilly districts. In the commune of La Bruguière, the forests on the slopes of the Black Mountain were cut down; the consequence of this removal of the trees was that a brook which ran at the foot, and the water from which was used for driving some fulling mills, became so dried up in summer as no longer to be of any use, while in winter the sudden floods caused very great damage in the valley. The forests were re-planted, and as the trees grew up the water coming to the brook was so regulated as to serve its former useful purpose in driving the mills, and the torrents in winter were moderated. Several other examples of a similar character are given.

In Switzerland, amongst other examples is quoted one that occurred in the canton of Berne, where, owing to the re-planting of the mountain-side with fir trees, the water again appeared at a spring which had ceased to flow. After a period the trees were cut down and the land converted into pasturage, since when the spring has almost disappeared, only opening out at occasional intervals.

In the Kazan district of Russia, once celebrated for its forests of oaks and linden, which are now nearly all cut down, there were formerly seventy water-mills constantly at work. Less than half now can be worked, and even they only run half time, and are idle in summer for want of water; while in winter the little rivers that worked these mills are converted into impetuous torrents, breaking up the mill dams and doing other damage. These abandoned water-mills stand out as a striking proof of the consequences of the destruction of forests.

In Sardinia, where the surface consists of plutonic rocks covered with a thin layer of earth, all the streams have a rapid slope. The woods, which occupied in 1870 an area of more than $2\frac{1}{2}$ million acres, or about 43 per cent. of the whole surface of the island, now are reduced to about one-sixteenth of this area. Since the removal of the trees the floods in the rivers rise with a rapidity and flow with a velocity never known before, and a great number of bridges have been destroyed by the floods. The beds of the channels have been raised in some places above the surface of the land, owing to the detritus brought down in floods.

In Wisconsin, U.S.A., the settlers cut down the forests and converted the land into tillage and pasture. During a period of about seventy years nearly the whole of the forest land was thus cleared, with the result that, as the forest disappeared, the water in the river became lower; finally thirty miles of the channel entirely dried up, and many water-mills that were formerly worked by the stream are now deserted and useless, owing to the want of water to run them.

In Sicily, owing to the cutting down of the forests on a vast scale in the province of Messina, the bed of the river has been raised by the stones and earth carried down by the torrents so as to stop all drainage from the land, and great damage has been done by the floods. Several other examples are given to the same effect where forests have been cleared in the same district, and these are compared with other streams where the forests still exist and their condition remains unaltered. In the former case, landslides from the mountains have become very frequent.

VARIATION OF GLACIERS.[1]

THIS interesting report of the Commission internationale des Glaciers shows that these ice-streams still continue to diminish in those parts of the world which it has been possible to examine. In the Swiss Alps, of ninety glaciers observed, not one shows an advance, which fully confirms the general results of the last seven years, and indicates that any slight variation is now at an end; the same is true of the Italian Alps, though some of them give signs of increase in their upper parts. In the French Alps (Pelvoux district), the Glacier Noir has steadily decreased since 1860; the Glacier Blanc, after decreasing from 1865 to 1886, advanced from about 1889 to 1896, but is now again retiring. It is noteworthy that the average elevation of the supply basin of the former is from 2500 to 2800 metres, and of the latter from 3000 to 3300 metres. In the Savoy Alps the shrinkage continues, some small glaciers having disappeared. The same is true in the Pyrenees.

In Norway both snowfall and temperature were rather variable in 1904, but the glaciers, with a few exceptions, have retreated; and in Greenland the Jakobshavn Glacier has shrunk, sometimes rather considerably. In the Caucasus (central) the glaciers continue to retreat; less is known of the eastern district, but the same apparently is true of it. During the past year M. Fedtchenko visited more than 110 glaciers in the Pamir, and has stated that all appeared to be diminishing. The same is true, with a few exceptions, of the north-western part of the United States, as well as of the mountain region of western Canada. In Africa, though the rainfall had been unusually heavy in the Kilimanjaro district, the amount of snow in the crater of Kibo had not, according to

[1] "Les Variations périodiques des Glaciers." Dixième Rapport, 1904. Rédigé par H. F. Reid et E. Muret (Extrait des *Archives des Sciences physiques et naturelles*, t. xx., juillet et août.) Pp. 34. (Genève: Georg et Cie, 1905.)

Dr. Uhlig, increased since 1901. Thus the report indicates that the retreat of glaciers, which began about forty-five years ago, still continues, having overpowered the slight rally which has been occasionally perceptible during the last decade. T. G. B.

THE REVOLUTION OF THE CORPUSCLE.[1]

Air: "The Interfering Parrot." (*Geisha.*)

A corpuscle once did oscillate so quickly to and fro,
He always raised disturbances wherever he did go.
He struggled hard for freedom against a powerful foe—
An atom—who would not let him go.
The æther trembled at his agitations
In a manner so familiar that I only need to say,
In accordance with Clerk Maxwell's six equations
It tickled people's optics far away.
You can feel the way it's done,
You may trace them as they run—
$d\gamma$ by dy less $d\beta$ by dz is equal $K.dX/dt$.
. . . .
. . . .
While the curl of (X,Y,Z) is the minus d/dt of the vector (a,b,c).

Some professional agitators only holler till they're hoarse,
But this plucky little corpuscle pursued another course,
And finally resorted to electromotive force,
Resorted to electromotive force.
The medium quaked in dread anticipation,
It feared that its equations might be somewhat too abstruse,
And not admit of finite integration
In case the little corpuscle got loose.
For there was a lot of gas
Through which he had to pass,
And in case he was too rash,
There was sure to be a smash,
Resulting in a flash.
Then $d\gamma$ by dy less $d\beta$ by dz would equal $K.dX/dt$.
. . . .
. . . .
While the curl of (X,Y,Z) would be minus d/dt of the vector (a,b,c).

The corpuscle radiated until he had conceived
A plan by which his freedom might be easily achieved,
I'll not go into details for I might not be believed,
Indeed I'm sure I should not be believed.
However, there was one decisive action,
The atom and the corpuscle each made a single charge,
But the atom could not hold him in subjection
Though something like a thousand times as large.
The corpuscle won the day
And in freedom went away
And became a kathode ray.
But his life was rather gay,
And he went at such a rate,
That he ran against a plate;
When the æther saw his fate
Its pulse did palpitate,
And $d\gamma$ by dy less $d\beta$ by dz was equal $K.dX/dt$.
. . . .
. . . .
While the curl of (X,Y,Z) was the minus d/dt of the vector (a,b,c).

[1] Composed by Mr. A. A. Robb and sung at the annual dinner of the research students of the Cavendish Laboratory, Cambridge, on December 6, 1905.

NOTES.

DR. N. L. BRITTON, director of the New York Botanical Garden, has been elected president of the New York Academy of Sciences.

DURING the meeting of the French Association for the Advancement of Science, to be held at Lyons next August, it is proposed, if the suggestion arouses sufficient interest, to arrange an exhibition of urban hygiene.

THE Brussels correspondent of the *Daily Telegraph* states that at the last meeting of the Academy of Science it was announced that Dr. Jacobs had conclusively proved cancer to have a bacterial origin. This is not the first time that similar positive statements have been made which subsequent research has proved to be fallacious, and all such reports must be received with the greatest reserve.

THE Morrison lectures of the Royal College of Surgeons, Edinburgh, have this year been delivered by Dr. Ford Robertson on the pathology of general paralysis of the insane. The main theme of Dr. Robertson's lectures is that general paralysis is an infective or germ disease caused by certain diphtheroid bacilli, which can be isolated from the blood and cerebro-spinal fluid of the patient, and the toxins of which by their action on the central nervous system induce the paralysis and other symptoms.

THE Milroy lectures of the Royal College of Physicians of London will be delivered by Dr. W. H. Hamer on March 1, 6, and 8, the subject being "Epidemic Disease in England: the Evidence of Variability and of Persistency of Type." The Goulstonian lectures will be delivered by Dr. H. Batty Shaw, on the subject of "Autointoxication," on March 13, 15, and 20; the Lumleian lectures by Dr. Ferrier, the subject being "On Tabes Dorsalis," on March 22, 27, and 29; and the Oliver-Sharpey lectures by Dr. E. J. Spriggs on April 3 and 5, the subject being "The Bearing of Metabolism Experiments upon the Treatment of some Diseases." Prof. W. Osler will deliver the Harveian oration on St. Luke's Day, October 18, and Dr. S. J. Sharkey the Bradshaw lecture in November.

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 10–11. The council will shortly proceed to award Carnegie research scholarships, and candidates must apply before February 28. The awards will be announced at the general meeting. In place of the ordinary autumn meeting, a joint meeting of the American Institute of Mining Engineers and of the Iron and Steel Institute will be held in London on July 23–29. The Lord Mayor of London has consented to act as chairman of the London reception committee, and will give a conversazione at the Mansion House on the evening of July 24. The annual dinner will be held at the Hotel Cecil on Friday, July 27. A programme of the visits and excursions to be made during the meeting will be issued when the arrangements are sufficiently matured.

THE death is announced, at the age of eighty-three, of M. Jules Despecher, who for more than half a century played a prominent part in organising and arranging submarine cable services.

THE commission for the methods of examining and methylating alcohol, appointed by the French Government, has decided to offer the following prizes for open competition, irrespective of the nationality of the competitors:—(1) a prize of 20,000 francs for a method of methylating alcohol, which shall be preferable to that now in vogue in France, and which at the same time shall prevent any

defrauding of the revenue; and (2) a prize of 50,000 francs for a system which shall permit of the use of alcohol for illuminating purposes under the same conditions as those for the use of petroleum. Further details and particulars may be obtained from the commission (though not before April), which body will itself decide to whom the awards shall be made.

The programme of the sixth International Congress for Applied Chemistry has recently been issued. The congress will be held in Rome from April 26 to May 3. On April 25 there will be a social gathering of those taking part in the congress, preparatory to the official opening on the following day; on the afternoon of the same there will be the first full committee meeting for the election of next year's officers. On April 27 the sittings of the various sections will begin, and will be continued on April 28 and 30, and on May 1 and 2. For Sunday, April 29, an excursion into the outskirts of Rome has been arranged. On May 3, after the final committee meeting, there will be two excursions, the one to the Island of Elba, and the other to Sicily. During the first, visits will be paid to the iron mines and works of Elba, whilst for the second arrangements have been made for visits to the saltworks of Erapani, the wine factories of Marsala, and the sulphur mines of Messina; but since the two excursions are taking place simultaneously, members of the congress may only participate in one of the two. All members will be entitled to reductions of from 40 per cent. to 60 per cent. on tickets issued by the State railways, according to the distances travelled.

The Philosophical Institute of Canterbury, Christchurch, N.Z., has opened a fund with the object of establishing a memorial to the late Captain F. W. Hutton, F.R.S., president of the New Zealand Institute. It is proposed to devote the fund to the encouragement of original research in natural science in New Zealand by making grants from time to time to persons engaged in original research, and by the award of a bronze medal, to be called the "Hutton medal," for original contributions of special value. In the appeal for support, the memorial committee remarks:—"The influence and importance of research are becoming more and more fully recognised in all parts of the world, but New Zealand has as yet taken no steps for its encouragement, and no financial assistance has so far been given to private workers in any department of science. It is hoped, therefore, that advantage will be widely taken of the present opportunity of contributing to a fund which will encourage research, and will at the same time perpetuate the memory of Captain Hutton, who so unselfishly devoted himself throughout his lifetime to the advancement of natural science in New Zealand." Though the Philosophical Society has taken the matter in hand in order to save time, and has subscribed 50*l*., the board of governors of the New Zealand Institute will probably be asked to take over the work of collecting the funds required. Meanwhile, subscriptions may be sent to Dr. Chilton, Canterbury College, Christchurch, N.Z., who is acting as hon. treasurer of the fund.

From the *British Journal of Photography* (January 26) we read that an international exhibition of photography is to be held this summer at Paris at the Petit Palais, in the Champs Elysées, and will be open from July 16 to October 10. Judging even by the brief statement given, the exhibition will be on a very large scale, there being thirteen groups of exhibits, comprising altogether sixty-three classes. A list of the groups is as follows:—History of photography; applications of photography to science; educational; amateur and pictorial photography; photographic periodicals; professional photography; photographic publications; photographic materials; apparatus and accessories; photo-mechanical processes; industries related to photography; leather dressing; photographic illustrations, and the photographic trade. Such a comprehensive programme will, we hope, bring together workers in all sections, and include a strong British exhibit. In the second group the exhibition is assured the support of a large number of scientific institutions in France and other countries, including the Collège de France, the Museum of Natural History (Paris), the Paris National Observatory, the physiological station at the Parc du Princes, the Marey Institute, the Institute Pasteur, the Faculté de Médecine, the Sorbonne, the School of Pharmacy, the School of Mines, the Smithsonian Institution (Washington), the meteorological observatories of France, and many others. It is stated that the last day for receiving applications for space is fixed for February 25 next, and that an English (?British) committee is in formation. It may finally be stated that no charge is made for exhibits coming under the head of the first three groups.

Among the contents of Nos. 24–27 of the *Sitzungsberichte* of the Royal Academy of Vienna for last year is a notice of Hymenoptera obtained during an expedition to south Arabia, and a summary of the zoological results of another expedition to the Sudan and Gondokoro. In a third paper Mr. A. Handlirsch discusses the phylogeny of the Arthropoda.

In the course of a paper on the natural history of the Warburton district, published in the December (1905) number of the *Victorian Naturalist*, the author mentions that frigate-birds are used in the South Sea Islands as letter-carriers. If captured young, they will return, like homing pigeons, to the island of their birth, and, taking advantage of this trait, the missionaries forward such birds to islands with which they desire to hold communication. When released from their new domicile they fly straight to their old home, where they alight on the identical perches on which they were accustomed to be fed. Later on it is mentioned that diamond-tailed geckos (*Phyllurus platurus*) are always found head-downwards on the rocks they frequent. They assume this position, according to the author, in order to make hawks believe that their heads are their tails; consequently, when seized by one of these birds, which invariably pounce upon what they regard as the head, the brittle tail snaps off, and the gecko wriggles away little or none the worse for the encounter.

We are glad to welcome the volume of the *Zoological Record* for 1904, which from its bulk bears testimony to the energy with which natural history studies are being carried on both in this country and abroad. A few changes have been made in the staff, but in the main the old contributors have remained at their posts. Errors, as usual, appear to be comparatively few, and in many cases are excusable. We notice, however, that the genus Lohmannella (spelt with a single *n*) appears among the mites, as well as (in its proper place) among the Vermes. In the myriopod section, which is written by a foreigner, the editor might well have amended the style of such names as Kaukasus, Wladiwostok, and Eastromelia, while in the Bryozoa he might have noticed that Miss Embleton gives "Memoirs of the Geological Survey of India" as the title of a paper. Again, in the bird section (p. 30) we find the same paper quoted twice over, on account of the fact that it appeared in two different journals. In congratulating the editor and his staff on their successful

labours, we may refer to the fact that they record the appalling total of no less than 2095 new generic and sub-generic names as the result of a single year's work!

IN the *Scientific Reports* of the Imperial Cancer Research Fund (No. 2, 1905) a valuable series of experiments and observations on the growth of cancer under natural and experimental conditions is detailed by Dr. Bashford and his co-workers. The statistical investigation of cancer has also been pursued, and a valuable report is presented. The provisional conclusion is arrived at that there is nothing in the statistical investigations of the Imperial Cancer Research Fund which points to an actual increase in the death-rate from cancer.

IN an interesting article in the *Quarterly Review* (January) Dr. George Pernet reviews the light-treatment of disease, with which the honoured name of the late Dr. Finsen, of Copenhagen, will always be associated. The action of the various rays of the visible and invisible spectrum on the lower forms of life is first detailed, and it is shown that the violet and ultra-violet rays are the active ones, and it is these which are employed for the treatment of lupus. At the same time, it must be recognised that light-treatment has its drawbacks; it is costly, slow in action, and does not influence all forms of the disease, particularly if at all below the surface, since the active rays have little power of penetration. It has recently been observed, however, that if the tissues be first treated with some fluorescent substance, such as eosin, the penetrative powers of the active rays are increased, and this fact may prove to be of practical value. Lastly Dr. Pernet points out that as lupus is a form of tuberculosis, the eradication of the disease is intimately connected with the larger question of the eradication of tuberculosis in general.

A LIST of pyrenomycetous fungi collected in Orleans County, New York, has been prepared by Mr. C. E. Fairman, and is published in vol. iv. of the *Proceedings of the Rochester Academy of Science, U.S.* A number of species are recorded for the first time for the State, and five are new to science.

UNDER the title of "Mesozoic Plants from Korea," Mr. H. Yabe contributes to vol. xx. of the *Journal of the College of Science*, Tokio University, a paper on fossil botany dealing with the collections obtained from a bed of coal shale in the vicinity of Naktong, a village near Sengchu. Twenty-one species, mostly ferns, but including a few cycads and conifers, are distinguished. From the similarity of several of these with species recorded from the Japanese Tetori series, the writer judges that the beds were formed contemporaneously; he also suggests that the plant-bed of Naktong was deposited as a beach formation in shallow brackish water.

IN connection with the fine avenues of trees at Quetta referred to in NATURE of January 11, p. 253, Mr. E. P. Stebbing has been investigating the ravages of a beetle, *Aeolesthes sartus*, that has locally received the name of the "borer." In a pamphlet printed by the Government of India, Mr. Stebbing sketches the salient points in the life-history of the insect. The damage is caused principally by the larvæ, that feed first in the phloem and sap-wood of the tree, and subsequently penetrate during the winter into the heart-wood. The trees that have suffered most have been the Kabul willow, the reamer poplar, and the elm; the walnut, horse-chestnut, ash, and robinia have escaped entirely or nearly so, and, curious to relate, the mulberry has not been attacked.

THE members of the Botanical Society of Edinburgh receive from time to time at their meetings interesting announcements of the discovery of rare plants found during summer excursions. Mr. J. G. Nicolson publishes in vol. xxiii., part i., of the *Transactions and Proceedings* of the Society a list of some rare Caithness plants, that includes *Arctostaphylos alpina*, collected on Mt. Morven, *Hierochloe borealis* from Thurso, and a strange alien, *Hymenaea Courbaril*, known as the West Indian locust, washed up by the Gulf Stream near John-o'-Groats. Mr. W. Young, writing on the plants of the Glenshee district, Perthshire, reports the occurrence of *Gentiana nivalis*, *Veronica alpina*, and *Cochlearia Groenlandica* among flowering plants on or near Glas Maol; among the liverworts gathered in the district were *Cephaloziella Jackii*, *Lophozia socia*, and *Harpanthus Flotowianus*. The volume contains the latest of many papers by Mr. W. West and Prof. G. W. West on algæ, in which they describe the fresh-water algæ collected in the Orkneys and Shetlands; their list enumerates more than four hundred species—a large number being desmids and diatoms—of which several are new species or varieties.

THE order Bombacaceæ, united by Hooker with Malvaceæ, includes, besides the baobab, several remarkable trees, of which the "silk-cotton" trees are a prominent feature in the tropics. Two genera pass by this name, Bombax and Ceiba, or, as it is known in this country, Eriodendron. At Nassau, in the Bahamas, there is a historic giant silk-cotton tree that is assigned to *Eriodendron anfractuosum* in an enumeration of the plants of the Bahamas. The illustration here reproduced is taken from *Forest and Stream*, January 13, and shows the remarkable formation of plank-like outgrowths, produced from the base of the trunk and the uppermost roots, that have received the name of plank-buttresses. The plank-buttress is a peculiarity of trees growing in a tropical climate with abundant rainfall.

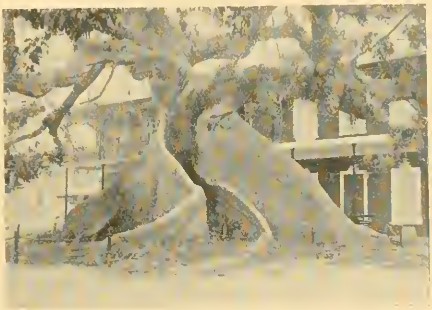


FIG. 1.—The Giant Ceiba Tree of Nassau—one of the famous trees of the World.

MR. AUDOIN contributes an interesting paper on the hydrography of Lake Tchad to *La Géographie* (vol. xii., No. 5). Recent observations of the volume of tributary streams and the area of the lake are analysed and applied to the examination of the question of the gradual desiccation of the region.

MR. MARQUARDSEN contributes a valuable and complete summary of the history of geographical exploration in the Lake Tchad region down to the year 1905 to the new number of the *Mitteilungen aus den deutschen*

Schutzgebieten (vol. xviii., part iv.). With this number is issued a new map of the region, and also a map of Togoland on a scale of 1 : 200,000.

PROF. H. FISCHER and Prof. F. Guillotel write in the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde (No. 10, 1905) and in *La Géographie* (vol. xii., No. 4) on the position of geography, and the teaching of geography, in the United States. In both papers there is much to interest and stimulate teachers of the subject in this country. We note with pleasure the well deserved tribute which both writers pay to the work of Prof. W. M. Davis.

WE have received the annual number for 1905 of *Mazama*, the publication of the well known American mountaineering club. Mr. Henry Gannett contributes a paper on Lake Chelan and its glacier, and Mr. H. F. Reid describes the glaciers of Mount Hood and Mount Adams. The rest of the number is chiefly devoted to accounts of the work of the club during the year. Some of the photographs illustrating the "Rainier outing" are of great excellence.

THE director of the new Japanese Meteorological Service of Corea, Mr. Y. Wada, has lost no time in searching for and publishing the results of observations existing in that country. The Journal of the Meteorological Society of Japan for November last contains summaries of rainfall observations for the years 1896–1904 discovered at Seoul, and compiled in the Chinese language by a Mr. Li. The mean annual rainfall is about 35·4 inches, of which nearly 25 inches fall in the three summer months; July has an average fall of 11·3 inches, and December only 2·8 inches. The greatest daily falls occur in June and July, and exceed 5 inches on rare occasions. Rain falls, on an average, on 94 days in the year, and snow on 19 days.

MR. J. R. SUTTON has communicated to the *Transactions of the South African Philosophical Society* (vol. xvi., part ii.) a useful paper entitled "Some Results of Observations made with a Black Bulb Thermometer *in vacuo*." Mr. Sutton states that the object of the investigation was chiefly to ascertain some of the effects of various meteorological influences upon the indications of the instrument, not to discuss its suitability for the purposes of physical research. We are glad to see, however, that he does not share the opinion that has been sometimes expressed by high authorities of the untrustworthiness of the black bulb thermometer. We think it has been recently shown that good instruments, after use for some years, give fairly accurate comparative results, and, this being the case, their indications afford useful observations which cannot otherwise be obtained at ordinary meteorological stations. The author's observations show *inter alia* that at Kimberley the differences between the maxima in sun and shade increase with fair uniformity from winter to summer, the temperature in the sun increasing faster than that in the shade. A monthly comparison of various elements for four years shows that there is not any very obvious relation between the solar temperature and either the state of the sky or the hygrometric condition of the air, except, roughly, that the amount of cloud is least and the temperature of the dew-point lowest in winter, when the black bulb temperatures are lowest and the difference of maxima least. The elements arranged in a sequence of cloud percentages show that the temperature in the sun is at its highest when the sky is half clouded. Mr. Sutton thinks this seems to indicate that when the sky is more than half covered the clouds are as likely to shut off the solar heat as to impede radiation from the thermometer. We are unable in this brief notice to refer to various other points of interest in the paper.

THE paper on worm contact read by Mr. Robert A. Bruce before the Institution of Mechanical Engineers on January 19 throws much light on the actions involved with worm gearing. Many writers have contributed to the theory of the subject, but hitherto experimental investigation has been singularly incomplete. Some of the most interesting aspects of the question are dealt with by the author, but further research work is necessary before a complete account of the action of worm-gearing can be drawn up. The author's paper will prove a valuable guide to students of applied mechanics, and forms a welcome addition to the proceedings of the Institution of Mechanical Engineers.

THE presidential address of Prof. J. F. Kemp to the New York Academy of Sciences is printed in full in *Science* of January 5. It deals in a popular manner with the genesis of mineral veins. Ores, he shows, gather along subterranean waterways. They may fill clean-cut fissures; they may impregnate porous rocks on either side; or they may replace entirely soluble rocks. As to the source of the water that accomplishes these results there has been much discussion, the crucial point relating to the relative importance of the two kinds of ground-waters, those from the molten igneous rocks and those derived from the rains. The author inclines to regard the latter, if not as the sole vehicle of introduction, as the preponderating one.

IN the current issue of the *Engineering Magazine* (January) there is an interesting account of the first attempt of the United States Government to develop a source of fuel supply in the Philippines, where the economic conditions are favourable, inasmuch as nothing in the shape of a competing private coal-mining industry is established there. Owing to the high calorific power of the coal available, and to the fact that there is an ideal harbour adapted for a coaling station, the small island of Batan was selected as the site for the Government coal mines. The coal is of Eocene age, and the greatest normal thickness of any seam on the island is 8 feet. The coal yields 40 per cent. of volatile constituents and 4 per cent. to 7 per cent. of ash, whilst the fixed carbon in several cases exceeds 50 per cent. The author of the paper, Mr. O. H. Reinholt, was in charge of the development, and the numerous illustrations he gives are reproduced from photographs taken by himself.

MR. CONSUL STEVENS, in his report on agriculture in the Trans-Caucasus for the year 1905, refers, writes a contributor to the *Journal of the Society of Arts*, to the ravages of locusts. The fields situated along the stretch of land north and south of the river Kura are often visited by this insect at a season of the year when, in view of the forward state of the crops, their presence proves most disastrous to the population. The Government has for some years been paying much attention to the destruction of locusts, and with this object in view has endeavoured to encourage the peasants to destroy locusts' eggs, or the larvæ. Accordingly the peasants dig holes or trenches, and during the months of June and July the villagers go out into the fields and drive the larvæ into the trenches. This measure has been crowned with a certain amount of success during the present season, and the havoc done to the crops by locusts has thereby been reduced to a minimum. No fewer than 13,905,276 days' *corvée* work was done between the years 1898 and 1904 in destroying locusts in the Sir.

Darya, Samarkand, Ferghana, Semirechi, and Trans-Caspian districts. This in itself shows the immense sacrifices the natives are called upon by the authorities to make in connection with the destruction of locust eggs. Between the years 1900 and 1905 the rural authorities of those localities paid away sums to the amount of 80,000*l.* for the destruction of locusts, and yet during this period the crops in Central Asia were damaged to the extent of 150,000*l.* by this insect.

THE publication in NATURE of December 7, 1905 (p. 132), of some verses on the passing of the atom, sung at the chemical laboratory dinner at University College, London, has induced Mr. F. Horton, St. John's College, Cambridge, to send us a copy of the post-prandial proceedings of the Cavendish Society, containing several metrical compositions inspired by recent work on ions and radio-activity. Songs of this kind are sung at the Cavendish research students' annual dinner, which is held at the end of each Michaelmas term; and the one by Mr. A. A. Robb reprinted elsewhere in this issue is a good example of versification in science.

IN two recent papers, the one by Mr. D. Himstedt and Mr. G. Meyer, published in the *Berichte* of the Freiburg Scientific Society (1905, vol. xvi., p. 13), and reprinted in *Le Radium* (vol. ii., No. 12), the other by Prof. B. Walter and Mr. R. Pohl (*Annalen der Physik*, iv., 18, 406), experimental evidence is brought forward to show that the light ordinarily emitted by radium bromide is principally due to the impact of the Becquerel rays on the particles of nitrogen in the immediate vicinity. The probability of this being the case was suggested by Sir William and Lady Huggins in 1903, although the latter were unable then to obtain direct evidence in support of their view.

AN important paper by Prof. A. W. Witkowski on the thermal dilatation of compressed hydrogen is published in the *Bulletin International* of the Cracow Academy of Sciences (1905, No. 6). Full details are given of the methods employed in determining the values, already published in a brief report to the British Association in 1904, of the volume coefficient of dilatation of hydrogen at temperatures ranging from $+100°$ to $-190°$ C. under pressures of 1–6n atmospheres. The results are used in discussing Wroblewski's calculation of the critical temperature and pressure of hydrogen, a subject which is also dealt with experimentally by Prof. Olszewski in the following number of the Bulletin (1905, No. 7). The critical pressure was found in a new determination to be 13·4–15 atmospheres, the critical temperature being $-240°·8$ C. Prof. Olszewski also describes in No. 7 an unsuccessful attempt to liquefy helium by allowing it to expand suddenly, after cooling to $-259°$ C. by means of solid hydrogen, from a pressure of 180 atmospheres. Not a trace of liquefaction could be observed at the temperature obtained in this way, which is calculated to be as low as $-271°·3$ C., or $1°·7$ absolute.

AT the last meeting of the physical-mathematical section of the Berlin Academy of Science, held under the presidency of Prof. Waldeyer, Prof. Landolt epitomised the results of his extensive experiments on the question of the possible change of weight caused by chemical action, and stated that he had obtained confirmation of many previous observations of a decrease in weight as a result of certain reactions, and that he had started further experiments with the view of discovering the cause of such changes. Prof. van 't Hoff gave a further contribution to his series of papers on natural salt formations, xlv., the occurrence of tincal and octahedral borax. In collaboration with Blasdale he had observed that the appearance of octahedral borax in Italy was dependent upon a minimum temperature of about $35°·5$ C. Prof. Waldeyer read a communication from Dr. A. Sachs, of Breslau, on kleinite, a hexagonal mercury oxychloride from Terlingua, in Texas. This mineral, to which the formula $Hg_4Cl_2O_3$ is given, is a third addition to the other two mercury oxychlorides previously found in this district, namely, eglestonite, $Hg_6Cl_3O_2$, belonging to the regular system, and the monoclinic terlinguaite, Hg_2ClO.

THE real existence of the *n*-rays, discovered by M. Blondlot, has been the subject of much discussion, there being a general consensus of opinion outside France that the effects produced are physiological. The *Comptes rendus* for January 15 contain two papers of considerable interest on this subject. The first of these, by M. Mascart, gives details of a series of measurements of the points of maximum intensity in the spectrum produced by the refraction of the *n*-rays through an aluminium prism, by a number of independent observers. The phosphorescent screen was mounted on the carriage of a dividing engine, and each of four observers (Messrs. Blondlot, Gutton, Virtz, and Mascart) made independent measurements of the points of maximum intensity. The most concordant figures were those obtained by M. Blondlot, but the general agreement of the results left no doubt as to the position of the lines. M. Mascart gives the results without comment. The second paper, by M. Gutton, is an attempt to prove the objective existence of the *n*-rays. It had been noted that if these rays are allowed to fall on the primary spark of a Hertzian oscillator, the lustre of the secondary spark diminishes. This effect has been secured photographically, the difference being clearly marked in the whole of the thirty-seven experiments. The apparatus is described in detail, and the precautions necessary for success pointed out. These two papers certainly provide material for consideration by those who maintain that the whole phenomenon is a physiological illusion.

PROF. HENRI MOISSAN has continued his experiments on the fusion and volatilisation of the more refractory metals in the electric furnace, and gives an account of his results in the current number of the *Comptes rendus* (January 22). In the first experiment, made with osmium, the temperature obtained by using a current of 500 amperes at 110 volts, although sufficient to distil 16 per cent. of the metal in four minutes, was not sufficient to melt the metal, except at the edges. Osmium was entirely fused with a current of 700 amperes at 110 volts in five minutes, but the fused metal contained nearly 4 per cent. of graphite. Under the same conditions of current and voltage as in the second experiment above mentioned, 150 grams of ruthenium were completely melted in three minutes, about 11 per cent. being distilled during the fusion. The fused ingot of ruthenium also contained graphite. Platinum could be distilled in the same furnace with great ease, and, indeed, Prof. Moissan remarks:—"The liquid metal distils with the same facility as water carried to 100° C." Palladium, iridium, and rhodium were also fused and distilled without difficulty, palladium being the easiest metal to fuse of all those examined in this group.

A SUMMARY of the weather for 1905 at Sevenoaks has been received from Mr. W. W. Wagstaffe.

MR. H. K. LEWIS's quarterly list of new books and new editions added to his Medical and Scientific Library (136 Gower Street, W.C.) during the last three months of 1905

includes more than 150 titles of books, above 30 of which are in the chemical, engineering, and electrical departments of the library.

THE "Writers' and Artists' Year-book" for 1906 has now been published by Messrs. A. and C. Black. It contains much information likely to be of assistance to writers on all subjects. The list of papers and magazines, good though it is, is by no means complete; for though details concerning *Science Siftings* are supplied, we have been unable to find any mention of the *Chemical News*, the *Entomologist*, the *Irish Naturalist*, and the *Zoologist*. The price of the year-book is 1s. net.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have ready for publication immediately the following books of scientific interest:—"Motor Vehicles and Motors," vol. ii., by W. Worby Beaumont; "Tunnel Shields and the Use of Compressed Air in Subaqueous Works," by W. C. Copperthwaite; "Modern Turbine Practice and Water Power Plant," by J. W. Thurso; "The Seven Follies of Science," by J. Phin; "Experimental Electrochemistry," by N. Monroe Hopkins; "Gas, Gasolene, and Oil Engines" (new edition), by G. D. Hiscox; and "Practical Electro-chemistry" (second edition), by B. Blount.

THE twenty-sixth issue of the "Englishwoman's Yearbook and Directory," that for 1906, has been published by Messrs. A. and C. Black. It maintains the high level of usefulness to which attention has on previous occasions been directed in these columns. Englishwomen anxious to take part in the useful work of the world owe a debt of gratitude to Miss Emily Janes, who edits the volume. Great prominence is, as usual, given to education, and the information given concerning the higher education of women is exhaustive and interesting. An alphabetical list of some distinguished women with their contributions to science and education should serve to encourage others to assist in the spread of knowledge.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 2. 5h. Jupiter in conjunction with the Moon. Jupiter 4° 39′ N.
,, 3. 5h. 23m. to 6h. 28m. Moon occults α Tauri (mag. 1·1).
,, 4. 10h. 6m. to 12h. 6m. Transit of Jupiter's Sat. III. (Ganymede).
,, 5. Juno (mag. 8·7) in opposition to the Sun.
,, 7. 7h. 7m. to 8h. 4m. Moon occults ζ Cancri (mag. 4·7).
,, 7. 9h. 33m. Minimum of Algol (β Persei).
,, 8. Total eclipse of the Moon.
17h. 57m. First contact with the shadow.
18h. 58m. Beginning of total phase.
19h. 47m. Middle of the eclipse.
20h. 36m. End of total phase.
21h. 37m. Last contact with the shadow.
19h. 30m. Moon sets at Greenwich.
Magnitude of the eclipse = 1·632.
,, 10. 6h. 22m. Minimum of Algol (β Persei).
,, 10. 11h. 7m. to 12h. 12m. Moon occults χ Leonis (mag. 4·7).
,, 14. Venus. Illuminated portion of disc = 1·000. Of Mars = 0·944.
,, 16. Juno ½° S. of ζ Hydræ (mag. 3·3).
,, 22. 19h. 43m. Partial eclipse of the Sun, invisible at Greenwich.
,, 24. 11h. Saturn in conjunction with the Sun.
,, 28. 7h. 0m. to 8h. 9m. Moon occults μ Ceti (mag. 4·4).

DISCOVERY OF A NEW COMET. A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Brooks at Geneva on January 26. Its position at 10h. (Geneva M.T.) on that date was

$$R.A. = 16h.\ 19m.\ 28s.,\ dec. = +47°\ 10',$$

which is near to τ Herculis.

The object is said to be a bright one, and to be moving in a north-westerly direction. Being the first comet to be discovered during the year, it will take the designation 1906*a*. At 9 p.m. τ Herculis is fairly low down, near to the N.N.E. horizon, and does not "south" until about 7.30 a.m.

A second telegram from Kiel states that the comet was observed by Dr. Palisa at Vienna on January 28. Its position at 15h. 13·3m. (Vienna M.T.) was

$$R.A. = 16h.\ 18m.\ 16{\cdot}4s.,\ dec. = +50°\ 4'\ 45''.$$

From this it appears that the comet is at present travelling nearly due north towards the constellations Draco and Ursa Minor.

COMET 1905*c* (GIACOBINI). As comet 1905*c* is now emerging from the immediate neighbourhood of the sun and is fairly bright, it should soon become visible in the evening sky, immediately after sunset, and in the south-west. The following is an extract from a daily ephemeris published by Herr A. Wedemeyer in No. 4067 of the *Astronomische Nachrichten*:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log r	log Δ
Feb 1	22 18 6	−25 9	9·6110	0·0616
3	22 40 39	−24 17	9·6634	0·0616
5	23 1 53	−23 9	9·7099	0·0633
7	23 21 49	−21 50	—	—
9	23 40 24	20 25	—	—

OBSERVATIONS OF STANDARD VELOCITY STARS.—In accordance with the international cooperative scheme for the regular determination of the radial velocities of ten standard stars, Mr. Slipher, using the Lowell spectrograph, observed the following stars during the summer and autumn of 1905. γ Cephei was substituted for α Crateris—the tenth star of the standard list—because the latter was too near the sun during the period covered by the observations. The mean velocity obtained by Mr. Slipher for each star is also given below:—

Star	No. of plates	Velocity
α Arietis	3	−14·3 km.
α Persei	5	− 2·5 ,,
β Leporis	3	−13·0 ,,
β Geminorum	3	+ 3·3 ,,
α Boötis	5	− 4·7 ,,
β Ophiuchi	3	−11·3 ,,
γ Aquilæ	3	− 2·1 ,,
ε Pegasi	4	+ 6·1 ,,
γ Piscium	3	−11·3 ,,
γ Cephei	3	−41·9 ,,

Mr. Slipher describes the equipment and the method of working, and directs attention to the fact that the high altitude of the Lowell Observatory and the prevalent transparency of the sky contribute greatly to the light-power of the equipment. Satisfactory spectrograms of α Persei were obtained in 15 minutes, whereas with the Yerkes equipment the shortest exposure on this star was 30 minutes (*Astrophysical Journal*, No. 5, vol. xxii.).

A FIRE NEAR THE MOUNT WILSON OBSERVATORY.—From No. 1, vol. xiv., of *Popular Astronomy*, we learn that a serious fire took place on Mount Lowe, near to Mount Wilson, on December 9, 1905. Fortunately, no damage appears to have been done to the observatory equipment, but the heat was so intense that Prof. Hale, fearing that some of the more delicate parts of the apparatus might be injured thereby, had them removed and sunk in the observatory reservoir until the danger was past.

MEMOIRS OF THE ROYAL SOCIETY OF NAPLES.[1]

THE greater number of the papers published in the last volume of the *Atti* of the Royal Society of Naples deal with geological and palæontological subjects connected with southern Italy. Dr. Maria Pasquale has prepared a catalogue of the fossil remains of Selachians, preserved with the University collections in Naples, and in various other museums in Italy. The majority of the species were already known through the writings of Prof. O. G. Costa,

FIG. 1.—*Hippocampus antiquorum.* From the Pleistocene Clay of Taranto.

who had originally formed the Neapolitan collection, and of Prof. Bassani, in whose custody the specimens now are. With the exception of one possibly Cretaceous species, all are Cainozoic, and no less than twenty-two species come from the *pietra leccese* (Middle Miocene).

The fish fauna of the Pleistocene Clays of Taranto is described by Prof. F. Bassani (No. 3, 59 pp., 3 pls.), principally from a collection of 700 specimens obtained by Dr. Marchesetti during the excavation of a new dry dock at Taranto in 1886. From beds of clay varying from 10 metres to 73 metres in thickness come 9 species of algæ, including the new *Grateloupia bassanii*, which form the subject of a special memoir by Dr. A. de Gasparis (No. 4, 8 pp., 1 pl.), and 29 species of fish, all of which are found living in the Mediterranean at the present day, and many of which may be seen on the stalls of the fish market in Taranto. Certain genera, Hippocampus, Scopelus, Maurolicus, Heliastes, Mullus, and Trachypterus, do not appear to have been recorded in the fossil state before these Tarantine discoveries. The occurrence of many individuals belonging to near-shore-living genera, like Solea, suggests that the fauna was essentially a littoral one, and the presence of such deep-sea types as Nyctophus (=Scopelus) or Maurolicus is hardly to be regarded in any other light than the occasional upheaval of the *dead* bodies of abyssal forms in the Straits of Messina at the present day. Bones of a dolphin are recorded from the same deposits.

[1] "Atti della Reale Accademia delle scienze fisiche e matematiche di Napoli." Vol. xii. (1905.)

Dr. M. Pasquale also contributes a short illustrated description of another fish, *Palaeorhynchus deshayesi*, Agassiz, from the Eocene deposits near Barberino di Mugello, Florence (No. 8, 7 pp., 1 pl.).

Two important contributions to the palæontology of the Gulf of Naples deal with the corals of Capri and with the Triassic shells of Giffoni, near Salerno. Prof. de Angelis d'Ossat has proved that the Capri limestones of Venassino, which have hitherto been generally believed to be of Tithonic age, in accordance with the view of Oppenheim (1889), are far more nearly related in their coral-fauna to the Urgonian rocks. Out of a total of 25 species of corals, 18 are shared with the Urgonian, only 1 with Tithonic deposits. Several species of Amphiastræid and Astræid corals are described and figured as new to science, and an Acanthocœnia is named after Dr. Cerio, the discoverer of this rich deposit, who has devoted so much of his life to the study of the natural history of Capri. The dolomitic limestone of Giffoni has already been made known by the work of Costa and Bassani on the fish-fauna. In Dr. Galdieri's memoir (No. 16, 30 pp., 1 pl., 21 figs.), which is in the main a revision of O. G. Costa's work of forty years ago, an attempt has been made to determine the exact chronological position of the Giffoni beds with respect to others both in Italy and the Alps. More material will be required before certain conclusions can be drawn, but at the present state of knowledge there is fair evidence of contemporaneity with the well known Triassic strata at St. Cassian.

An interesting note bearing on the same general subject of the limestones of the Bay of Naples is on the Scoglio di Revigliano, by Prof. de Lorenzo (No. 12, 4 pp., 2 pls.). Revigliano Island is a tiny islet rock of Cretaceous, perhaps of Urgonian, age, which, were the sea to be removed, would be seen to rise by itself from a gently sloping plain of volcanic deposits, among which pumice, like that which buried Pompeii in the year 79, would be conspicuous, as well as the products of other Vesuvian and Campanian eruptions. The strata of the little rock dip in the same direction as those of the Sorrentine peninsula, viz. to the north-west, and they indicate by their trend the existence of a great fault, all other trace of which is buried beneath the alluvial and volcanic deposits of the Sarno-Castellamare plain.

The granitoid and Filonian Rocks of Sardinia form the subject of a posthumous memoir of Carlo Riva (No. 9, 108 pp., 7 pls.), which has been prepared for the press by his friend and colleague Prof. de Lorenzo. After describing the petrographical characteristics of the chief varieties of rock in detail, the author gives a valuable account of seventeen localities in Sardinia where zones of contact between the granites and schists and calcareous rocks may be well studied, together with an appreciation of the metamorphic changes that have taken place at each locality. The memoir concludes with a discussion of the theories of the probable age of the granitoid rocks of Sardinia.

FIG. 2.—Revigliano from the south-east.

Dr. V. Bianchi has re-investigated certain parts of the brain of *Delphinus delphis* (No. 14, 16 pp., 3 pls.), and has compiled an interesting table setting forth his estimates of the relative numbers of neuroglœal corpuscles and of nerve cells in various regions of the cerebral cortex.

Although the cerebral hemispheres resemble those of the carnivorous type, yet the frontal lobes are so singularly under-developed that the author finds therein an explanation of the relative stupidity of the dolphin.

"Bidder's Organ" (Spengel) was discovered in 1758 by Rösel von Rosenhof upon the testes of *Bufo calamita*. Dr. Attilio Cerruti, by means of material captured in the volcanic crater of Archiagnano, near Naples, has been able to demonstrate a highly interesting cytological process which occurs in the male individuals of *Bufo vulgaris* during the early months of the year. Certain of the cells, named ovules, of the organ of Bidder are so strongly attracted by some of their neighbours that they actually penetrate their enveloping membranes, and their cytoplasm and nuclei flow into the invaded cells. In the majority of cases the penetration is simple, *i.e.* only one ovule invades a second, but multiple penetration has also been observed; and then in the case of ovules, say, *a*, *b*, *c*, *d*, ovule *a* will penetrate into *b*, *b* into *c*, *c* into *d*, &c. In all cases of penetration, degeneration ensues. Generally speaking, the invading ovule is the younger, and is one which has developed on the periphery of the organ, the invaded ovules lying nearer the centre. The author draws a suggestive comparison between this phenomenon and that of the fusion of Ascaris ova described by O. zur Strassen, which, if they develop at all, give rise to monsters.

There are also four mathematical memoirs. Signor D. de Francesco contributes a paper on the motion of a cord and on the equilibrium of a flexible but non-extensible surface (Nos. 5 and 6, 5 pp., 9 pp.), and Prof. E. Cesàro investigates the intrinsic representation of a surface (No. 7, 20 pp.) and the curve of von Koch (No. 15, 12 pp.). A lengthy contribution to the theory of ternary biquadratic form and its resolution into factors (No. 13, 102 pp.) is by the hand of Ernesto Pascal.

R. T. G.

PHYSIOLOGICAL ECONOMY IN NUTRITION.

ONE of the most remarkable points in the recent history of physiological research is the small amount of attention bestowed upon the important question of nitrogenous metabolism until within the last few years. The older work of Voit and of Pflüger has for long been regarded as authoritative, in spite of the fact that these two observers are not at one on many essential facts. They, however, agree that proteid food is a most essential constituent of our diet, and that a minimum allowance per diem of about 100 grams, corresponding to 16 to 18 grams of nitrogen, is necessary for the well-being and equilibrium of the average adult human individual. A dietary containing this amount of proteid or albuminous material would not be regarded by the average meat-eating Englishman to be a very liberal one, and is frequently exceeded.

So firmly rooted has this idea of a proteid minimum intake of 100 grams become that not only is it stated as an axiom in the majority of text-books, but it forms the basis of dietaries prescribed by responsible Governments for use on military service, &c. The doctrine that proteid food is the most necessary of all foods is so thoroughly ingrained, even upon the lay public, that in popular parlance the words nutritious and nitrogenous are almost synonymous. This is a very dangerous mistake, for the non-nitrogenous constituents of diet, the carbohydrates and the fats, are equally necessary for the maintenance of bodily heat and energy, and so are equally, though in a somewhat different sense, to be regarded as nutritious. An example of this erroneous way of regarding food is to be seen in advertisements that meet the eye everywhere; preparations of milk, for instance, are sold which contain mainly the proteid matter of that fluid, and are vaunted as containing all the nutritious elements, the other constituents being looked upon as useless. As a matter of fact, milk is of special value on account of the admixture of the non-proteid with proteid material. In the concentration camps which were established during the later phases of the South African War, such hardships as occurred there were mainly due, not to lack of proteid nutriment, for the standard of nitrogen was fully maintained, but to lack or scarcity of vegetables and other sources of carbohydrate food.

For some considerable time, certain experimenters in Germany have striven to demolish the fetish of the irreducible minimum of the 16 or 18 daily grams of nitrogen, but their work has not attracted world-wide acknowledgment; the experiments they recorded were either made for too short a time or on too few people to be regarded as epoch-making.

It has been left to America to make the question one of immediate and urgent attention, and I propose in this article to bring the conclusions of these American investigators before the readers of NATURE.

Prof. R. H. Chittenden, of Yale University, and Dr. Otto Folin, of Waverley, Massachusetts, are the two principal exponents of the new doctrine, and I propose to deal with them in that order.

The Work of Chittenden.

Chittenden has been working at the subject for some years, and the results of his labours are given in a volume which will amply repay perusal entitled "Physiological Economy in Nutrition" (New York: F. A. Stokes Co., 1904). A more popular exposition of his ideas has been published in a recent number of the *Century Illustrated Monthly Magazine* (October, 1905, p. 859 *et seq.*).

The question was first brought to the notice of Prof. Chittenden by Mr. Horace Fletcher, who states that he cured himself of dyspeptic troubles by lessening his proteid nutriment below what was regarded as the physiological standard. He has started a propaganda on the subject from the economic point of view, for proteid is the most expensive of the articles of diet. One at once sees that the question is not merely one for the student of science, but is most important for the man in the street as well. Owing, no doubt, to his lack of physiological knowledge, Mr. Fletcher attributed the benefits he derived to a thorough mastication of the comparatively small amount of food he took. Mastication is, of course, of importance, but it does not possess the superlative importance attributed to it by Mr. Fletcher, and will not explain the results of the experiments made by Chittenden and his fellow-workers.

The number to which I have already alluded (16 to 18 grams of nitrogen a day) is based roughly on the usual diet of the meat-eating nations, and it is argued that habit and instinct alike are safe guides in determining such a number, and the effects of such a diet in the maintenance of health and bodily equilibrium have been abundantly proved through centuries of experience. It forms, as already stated, the basis of the usually accepted dietaries of Ranke and of Voit.

In other nationalities, it is true, a different figure has been arrived at, and the same argument of habit and experience might equally well be used in its favour. Thus in certain semi-civilised races the proportion of flesh food is much larger, and in other races, again—and this is the commoner variation—the proteid intake is less. We need, however, only consider the second alternative, for one can hardly suppose anyone will advocate a return to more carnivorous habits. It is alleged that in such nationalities as the Japanese, or in groups of people like vegetarians, and in certain rural populations, health and equilibrium are as well maintained as in the ordinary meat-eating inhabitants of our large cities. Those who hold that the number 16 to 18 is the correct one have explained the different number arrived at by the nations of the Far East as a racial difference propagated by long centuries of inheritance, or have tried, more or less successfully, to show that such people come nearer to Voit's standard than had been supposed, or else that they are not properly nourished.

Such explanations will not hold water when applied to the experiments conducted by Prof. Chittenden upon himself, his colleagues, his students, and upon a considerable number of athletes and soldiers. These experiments lasted in all cases for months, and in some for more than a year. The proteid intake was reduced to half, and in some cases to less than half the number hitherto regarded as normal. After a variable initial drop in body-weight, the deprivation was apparently followed by no untoward results. Equilibrium was maintained; the health remained

perfect or improved; the muscular power of athletes was increased; mental acuity was undiminished; and desire of richer food disappeared.

Chittenden argues from such results (and daily observations were diligently maintained throughout each experiment) that his scanty proteid diet is the normal, and that the average meat-eater is the man who is abnormal. He says:—"When we recollect that these eighteen grams or more of nitrogen in the urine reach the final stage of urea, &c., only by passing through a series of stages each one of which means the using up of a certain amount of energy to say nothing of the energy made use of in digestion, absorption, &c., we can easily picture to ourselves the amount of physiological labour which the daily handling by the body of such amounts of proteid food entails. It needs very little imagination to see that a large amount of energy is used up in passing on these nitrogenous waste products from organ to organ or from tissue to tissue, on the way to elimination, and we can fancy that liver and kidneys must at times rebel at the excessive labour they are called upon to perform." He then goes on to point out that many of these waste products, like uric acid, are toxic, and the evil results that ensue from their accumulation.

It is on such grounds that Chittenden advocates a revolution in our ordinary dietary, and his arguments for temperance in proteid intake are entitled to careful attention. He is no crank or faddist, and his conclusions have been arrived at by the true scientific method, that of experiment.

There will be many who will pay no attention to them at all. The *bon vivant*, for instance, will resent any interference with his habits, gout and other evils notwithstanding; and certainly some of the meals Chittenden describes do not appear very appetising; for instance, a banana and a cup of coffee for breakfast; bean soup, bread (1 oz.), bacon ($\frac{1}{6}$ oz.), fried potato, salad, prunes, and another banana for supper. But no doubt variations in the way in which the nutriment can be obtained are possible of introduction.

The honest inquirer after truth may also have his doubts, and it cannot be disputed that there are difficulties, and serious ones, which will have to be answered before the advocacy of the new idea will meet with success.

One would like to know, for instance, whether the numerous subjects of the experiments are still keeping up their reduced diet, or whether they have returned to the flesh-pots after a period of enforced abstinence. If they are still maintaining their new habits, one would like to know how they fare in a few years' time, if they have the reserve force to enable them to withstand a severe disease, great fatigue, or privation during a siege, and whether the initial briskness they felt when they dropped their large (probably too large) proteid intake is maintained, or whether, on the other hand, they present the appearance and symptoms of underfed persons.

A cautious and conservative person would point to the danger of a sudden change in the habits of years and generations, even though it may ultimately be necessary. Most physiologists will recall the analogy of metabolic changes to commercial undertakings which they employ when presenting balance-sheets of intake and output in the body, and say, just as in a business enterprise, a large turnover implies healthy activity, so in the body a frequent exchange of the old for the new is within certain limits an indication of vigour, and a necessary accompaniment of healthy action. The liver, the function of which it is to turn nitrogenous metabolites, which may be harmful, into urea, which is harmless and easily disposed of, is adequately large and active in health to deal with considerable quantities of material.

Then we may point to the stunted and feeble inhabitants among the poor and ask why they are so. Unhealthy dwellings, excess of alcohol, insufficiency of light and pure air will explain a good deal of their condition; but is it not underfeeding, especially in early life, which is at the root of the matter? They have had *nolens volens* to subsist on a diet very like Chittenden's, but their nutritive condition is not such as to make people who can afford a more liberal table inclined to follow their example.

Further, one may inquire, why is it that, with a few exceptions, the meat-eating nations have risen to the front? and why is it that in countries like India, where the native population is diluted with the white races, it is the former who are more readily attacked by disease, and more easily succumb to its effects?

A question intimately related to that of a suitable diet for the healthy adult is that of the feeding of children. The diet of the growing infant is relatively far richer in proteid than that of the adult. Must we also reduce the intake of proteid food in the child? This is a question that Chittenden has not touched, but clinical experience does not point, so far as I can ascertain, to an affirmative answer, either with regard to the feeding of infants or of certain classes of invalids.

These questions and difficulties cannot be answered offhand. There is a wide field still open to investigators, and not until such difficulties are removed will it be possible for physiologists to state that Prof. Chittenden has convinced them.

The Work of Folin.

Whether Dr. Otto Folin has seen these difficulties or not, he certainly does not mention them, and he appears as an advocate of the new doctrine, not only from a study of Chittenden's investigations, but also as a result of his own researches. Nitrogen enters the body in the complex compounds known as proteids; it leaves the body mainly by the urine in the shape of certain simpler substances of which urea is the most abundant. Folin has approached the subject from the aspect of nitrogenous discharge, and has published his investigations on the urine in a series of three interesting papers in the *American Journal of Physiology* (vol. xiii., 1905, pp. 45–65, 66–115, 117–138). Although it is possible that some of his conclusions may not stand the test of time, all of them are most suggestive, and his theory of proteid-metabolism will stand out as one of the most important contributions to physiological literature that has appeared within recent times.

The question, what is a normal diet? is intimately bound up with another, and that is, what is a normal urine? The text-book statements on the composition of this fluid are all derived from the examination of the urine of people accustomed to the Voit dietary; but if the diet of the future is to contain only half as much proteid, the urine of the future will naturally show a nitrogenous output of half that which is now regarded as normal. In people on such reduced diets, Folin shows that the decrease in urinary nitrogen falls mainly on the urea fraction, and in some cases the urea accounted for only 66 per cent. of the total nitrogen eliminated. The other nitrogenous waste products alter but little in absolute amount, but relatively their amount rises; in particular, the creatinine remains remarkably constant in absolute amount in spite of the great reduction in the proteid ingested. He goes on to point out that the laws governing the composition of urine are the effect of more fundamental laws governing proteid katabolism. Voit's well known theory on this question states that katabolism, *i.e.* the breaking down stage, occurs only in "circulating proteid"; the small amount of "living proteid" which dies is dissolved, and is then added to the "circulating proteid," where the final breakdown into waste products takes place. Pflüger, on the other hand, believes that all proteid taken in as food is first assimilated and becomes a corporate part of living cells before it undergoes the katabolic change. This view has met with more general acceptance than Voit's. The opinion held by Folin is that neither of these extreme views is correct, but that nitrogenous katabolism is of two kinds: one is inconstant and immediate, varies with the food, and leads to formation of urea and inorganic sulphates, but not of creatinine and "neutral sulphur." The other is smaller in amount, constant in quantity, and is largely represented by creatinine, "neutral sulphur," and to a less extent by uric acid and ethereal sulphates. This latter form of metabolism, representing the breakdown of actual living substance, may be termed tissue or *endogenous* metabolism, whilst the other is *exogenous*. Exogenous metabolism therefore represents an immediate discharge of the nitrogenous constituent of proteid matter, leaving the non-nitrogenous moiety available for use in heat and energy production, fulfilling, in other words, the same func-

tion as carbohydrate and fat. Endogenous metabolism sets a limit to the lowest level of nitrogenous equilibrium attainable, and the proteid necessary to balance this part of the nitrogenous waste is indispensable for the repair of the tissues. Whether the amount exogenously katabolised can be entirely dispensed with is at present questionable. I fancy most physiologists would agree that it cannot with safety be wholly dispensed with; the body would then be working too dangerously near the margin, and in any case where an excess of nitrogenous waste is necessary the call would have then to be made on the tissue proteids.

Recent researches on digestion of proteids in the alimentary canal have shown that they are largely broken down into simple substances like ammonia, leucine, tyrosine, and other amino-acids. This is regarded by Folin as a preliminary means of getting rid of the excess of proteid matter usually ingested; these waste products, according to this view, are taken to the liver, rapidly transformed into urea, and so got rid of. The evidence that they are synthesised by the cells of the body into "living proteid" is regarded by him as inconclusive and largely teleological. An extensive formation of Voit's "circulating proteid," to be followed immediately by decomposition into urea, is quite as improbable as the corresponding formation and decomposition of Pflüger's organised protoplasm. The organism requires in its food only the small amount of nitrogen necessary for endogenous metabolism; the nitrogen of the extra proteid is unnecessary, and the organism has at hand an active mechanism for casting it out.

To attempt to summarise all the points of detail into which Folin enters is beyond the scope of this article; all I desire to do is to bring forward the main principle of the new idea. There is, however, one further point of sufficient importance to warrant specific mention, and that is the one related to muscular work. The fact that muscular work does not increase proteid katabolism may be accepted as an approximate truth; it is not absolutely true; there is a certain increase of nitrogenous waste, but it is insignificant as compared with the enormous and immediate increase of waste carbonaceous products like carbon dioxide that are discharged when muscles are thrown into action.

If current views on the nature of proteid katabolism are correct, this fact is very difficult to explain, but it becomes intelligible if proteid katabolism, in so far as its nitrogen is concerned, is independent of the oxidations which give rise to heat or to the energy which is converted into work. "Whether severe work will have an effect on the endogenous metabolism cannot be shown by investigating urea excretion; determinations of creatinine and 'neutral sulphur' are necessary for a study of that question" (Folin).

One of the benefits such papers as those of Folin confer is that new ideas of this kind suggest fresh work to others, and it can hardly be doubted that in the future physiological literature will contain many papers criticising and supplementing the theories and facts which Folin has brought forward. Already one of these has appeared in the current issue of the *Journal of Physiology* (Noël Paton, vol. xxxiii., p. 1, 1905). In this Dr. Noël Paton on the whole agrees with Folin concerning the dual nature of proteid metabolism. He, however, differs from him in certain points of detail. He finds in the dog, for instance, that creatinine excretion is not so constant a quantity as in man. He also doubts whether it is possible to draw any hard and fast line between endogenous and exogenous metabolism, and that urea may be a final product of both. He explains some of Folin's results by variations in the activity of the liver, for it is in this organ that ammonia compounds and the like are transformed into urea. A study of various diets upon the flow of bile (which may be taken as an index of hepatic activity) shows that proteid diet specially stimulates the metabolic processes in the liver. Hence on a diet which is poor in proteid the hepatic action may be sluggish, and will therefore fail to convert a large quantity of waste nitrogen into urea, while on a diet rich in proteid the conversion must be much more complete. As with the nitrogen, so with the sulphur, the amount of which is completely oxidised must be determined by the activity of the changes in the liver.

Such, then, is a brief summary of some of the recent work in connection with these most important problems. We can hardly doubt that the steps made are in the direction of progress of knowledge, but it is as yet too early to prophesy where they will ultimately lead us.

W. D. H.

PHOTOGRAPHY IN NATURAL COLOURS.

An exhibition of photographs in which the aim of the photographer has been to imitate the colours of the objects represented is now open at the offices of the *British Journal of Photography*, 24 Wellington Street, Strand, and will remain open until the beginning of March. The specimens are all direct photographs in the sense that they have been produced by photographic printing, and not in printing presses from blocks or plates. The editors of the *British Journal of Photography* must be congratulated in that they have succeeded in bringing together a more representative collection than has ever been on view before.

The first glance that one instinctively takes round a room immediately on entering it produces a feeling quite different from that experienced on giving a momentary and general look round in a small gallery of paintings. In the latter case there is an impression of completeness in the work that gives satisfaction, whether or not this is maintained when the pictures are more carefully examined; but here there is a sense of a want of finish, an impression of experiment or incompleteness, as if those who made the pictures had left off before they had got the effect they sought to get. Perhaps others will not experience the same feeling, but it was very marked in the case of the writer, and, so far as the origin of it could be traced, it appeared to be due to a general crudeness of colour, or the predominance of one certain colour over the whole picture, or an indecision of outline that was evidently not intentional. Some examples suffer in one way and some in another; a few are quite satisfying, and must be very excellent if not perfect, but they are not in a sufficient proportion to affect the general impression.

It will hardly require technical knowledge to convince the visitor that the personality of the photographer has a great deal to do with the result. The more skilful the worker the better the photograph, that is, the more true are the colours and the fewer the errors of manipulation in all ways. As the skill of the worker has so much to do with the result, it is impossible to decide as to the merits of the various methods. Strictly speaking, it is not possible to determine the value of any of the photographs, for in no case is the original put by the side of it. Who would ever dream of attempting to judge the merits of a copy except by comparing it with the thing copied? Yet the writer has never seen or heard of a demonstration of the possibilities of a method of colour photography by an exhibition of a coloured object and its photograph side by side.

The effect of the personal element, or, in other words, the varying skill (or perhaps the varying luck) of different workers, is very clearly shown in the examples of the same process by different persons, or where an optically inferior method gives a better result. As an example of this last we would refer to Nos. 12 and 33, both apparently from the same group of fruit, &c., and both made of three superimposed films. In No. 33 the films are not cemented together, yet this picture is brighter than the other.

The only example of the immediate production of the colour of the incident light, and in this case the colour is not pigmentary but due to interference and visible only at a certain angle, is a very successful spectrum by the Lippmann process contributed by Mr. E. Senior. With two or three exceptions, the rest of the exhibits are three-colour prints. The fundamental principles are the same in all. Three-colour records are made by photographing the object through coloured media, getting the red, green, and blue of the object separately recorded. From these three negatives suitably coloured prints are made and brought together. In the Joly process, two specimens of which are lent by Mr. E. J. Wall, the three colours are arranged in series of fine parallel lines, and it is necessary to get so far away that these lines are indistinguishable, otherwise they are annoying to the spectator. The starch-grain method of

Messrs. Lumière gets over this difficulty of the lines by coating a plate with a single layer of starch granules which have been previously suitably coloured in three batches and then well mixed. The disposition of the three required colours is thus irregular, and the separate points of colour are too small to be discriminated by the naked eye. Unfortunately, no example of this method is on view; probably the inventors do not care to show their results until they have perfected the process. But this is the only notable process not represented.

In the rest of the exhibits the three coloured prints are superimposed, the variations being in the methods of their production and assembling. In the Sanger-Shepherd process three separate films are prepared, stained, and cemented together. Several exhibitors have adopted this process, chiefly in the production of transparencies, but there are a few prints on paper, and of these a portrait, No. 11, is worthy of special commendation. Dr. B. Jumeaux's modification consists in getting the blue element as a toned bromide print, and then superimposing the red and yellow films. Captain Lascelles Davidson and Mr. O. Pfenninger show specimens in which the films are superimposed but not cemented together, and there are other modifications that are not described.

Instead of three stained films, the prints may be prepared from pigmented tissue by the ordinary carbon process. The Autotype Company, the Rotary Photographic Company, Mr. W. E. Brewerton, M. Leon Vidal, the Lumière N.A. Company, and Dr. A. Hesekiel and Co. exhibit prints by various modifications of this method of working, the last named adopting the Selle process introduced several years ago. Mr. W. E. Brewerton shows how the gum bichromate process may be adapted for the purpose, each of the three coloured elements being produced in turn on the same sheet, with no transferring. The two "winter landscapes" by Dr. H. Bachmann are stated to be three-colour prints in gum bichromate, but the colours are scarcely, if at all, perceptible. The "pinatype" process has recently been described in these columns. In this case three colours are absorbed in turn into a single gelatin film from prepared gelatin films previously soaked in the colour solutions. Messrs. Fuerst Bros. show specimens of it, and Dr. E. F. Grün some results of undescribed modifications.

One of the most interesting exhibits is the group numbered from 52 to 56, examples of coloured prints obtained by a single exposure of a piece of coated paper under the coloured original, the colours being reproduced in the print. The sensitive material has the necessary three colours, each in its own film, superimposed, so that it appears black. By exposure to white light the dyes are all bleached, but if the light is coloured the corresponding colour is not bleached, because the dye does not absorb light of its own colour. This process has been worked at for many years by several investigators, the fundamental difficulties being to find the colours of the right tints that shall be sufficiently sensitive, that is fugitive to light, and can be made sufficiently stable when the print has been produced. These examples are by Szczepanik's method, and show surprisingly bright and clean colours. It is a pity that the original "lithophanes" are not shown as well as the copies, as many will doubtless consider that they are withheld because the comparison would not be to the advantage of the prints. Whether this is so or not, the results are wonderfully good considering the difficulty inherent in such work.

Of the three negatives exhibited by Dr. J. H. Smith and Co., obtained by one exposure in an ordinary camera, the plate used having superimposed on it three sensitive films with the necessary colour screens, there is nothing to be said, as there is no example of the plate used or of the print that the negatives might give. The results on "multico" tissue, which has several layers of pigmented tissue and is used as in carbon printing, the "mars star" prints which are produced by applying colours to bleached bromide prints, and the two portraits by Mr. Burgess can hardly be regarded as serious attempts to reproduce mechanically the colours of the originals until more is known about them. They are better described as colour effects, and there might be some interest attaching to them if the methods of their production were known.

C. J.

THE INTERNATIONAL METEOROLOGICAL CONFERENCE AT INNSBRUCK.

Fourth Meeting, September 14, 1905.[1]

THE president, Prof. J. M. Pernter, announced that after the discussion of a proposition made by Father Froc the meeting would proceed to elect the International Committee. By accepting Father Froc's proposition, the committee recommended the observation of the zodiacal light whenever possible, and assigned a definite symbol for use in reports.

On the proposition of Prof. von Bezold, the following committee was re-elected:—Messrs. Chaves, Davis, Eliot, Hellmann, Hepites, Hildebrandsson, Lancaster, Mascart, Mohn, Moore, Palazzo, Paulsen, Pernter, Russell, Rykatcheff, and Shaw.

Also, on the proposition of Prof. von Bezold, Prof. Nakamura, of Japan, was elected in succession to the late Dr. Billwiller.

Prof. Pernter proposed that the presidents of the commissions should be added to the committee, but it was decided that six months' notice should be given of any propositions which would affect the constitution of the committee.

Prof. Hildebrandsson presented the report of the commission on squalls. It was arranged that the question of the study of squalls should be left in the hands of Messrs. Durand-Greville, Hildebrandsson, and Shaw, and that meteorological institutions, including aëronautical stations, should be asked to send to these gentlemen, upon demand, for a certain number of days, about ten per year, the necessary observations for the construction of accurate charts of isobars, with the diagrams of pressure, temperature, and wind for the purposes of this special study.

Prof. Hellmann reported on behalf of the commission on the international code and on the comparison of barometers. The conference considered the publication of the international code, of the resolutions passed by, and of the papers presented to, the international conferences to be a valuable and powerful means of facilitating and developing international meteorological research, and expressed a hope that the meteorological institutions in Berlin, Paris, and London would undertake the publication in German, French, and English. Thanks were voted to Father Algué, who proposed to publish them in Spanish, and to Profs. Hellman and Hildebrandsson for their preparation of the code.

After some discussion as to the best means of comparing the barometers in different countries, it was decided to put into operation the decision of the conference at Vienna relating to the inspection of the stations in the control of each country. The comparison, wherever possible, was to be extended to extra-European countries. This work was left to Prof. Hellmann and General Rykatcheff.

General Rykatcheff presented propositions from the magnetic commission dealing with the necessity of bringing the magnetic instruments in the various observatories into agreement, and with the desirability of an early exchange of diagrams after days of magnetic storms, or whenever the records may be specially interesting.

Fifth Meeting, September 15, 1905.

The president of the solar commission, Sir Norman Lockyer, presented the report of the meetings of that commission during the preceding days, and also the report of the meeting at Cambridge in 1904. The committee approved of all the resolutions contained in the report, and re-elected the commission, with Sir Norman Lockyer again as president.

The commission expressed the opinion that permanent meteorological observatories should be established in the north of Siberia and America, at least two or three in each country. It also desired to obtain all the observations that may have been made in a large number of islands scattered over the globe, the names of which were given, and insisted on the necessity of continuing these observations, asking that the attention of the Governments concerned should be directed to this matter. Directors of

[1] Reports of the proceedings of the first three meetings appeared in NATURE of September 21 and October 5, 1905 (vol. lxxii., pp. 510 and 562).

meteorological services were asked to furnish data of the heights and flow of rivers and lakes whenever possible.

M. Teisserenc de Bort reported from the commission on the atlas of clouds, and gave particulars of certain alterations in the plates in that atlas and in the definition of stratus cloud.

M. Teisserenc de Bort and Dr. Rotch gave an account of an expedition through the regions of the trade wind and equatorial calms in the North Atlantic. M. de Bort gave the history of the expedition and the results of the observations obtained by means of captive balloons, and Dr. Rotch gave those obtained by kites. Prof. Hergesell followed with the results similarly obtained in the Mediterranean on board the yacht belonging to the Prince of Monaco.

Dr. Köppen announced that the German hydrographical expedition to the Bismarck Archipelago would similarly use balloons and kites during the voyage.

Prof. Mohn reported from the commission on meteorological telegraphy.

M. Polis directed attention to the fact that the *Daily Telegraph* already announces the coming of storms from the Atlantic, using observations sent by means of wireless telegraphy from ships at sea. The conference then passed the following resolution:—"This conference is convinced that wireless telegraphy is chosen to render in the future great service in the forecasting of the weather in the Atlantic, but before introducing it into the current service of the meteorological institutions it is indispensable to take satisfactory precautions for the control of the observations transmitted. The conference asks the Meteorological Office in London to prepare as quickly as possible a report on this question, and communicate with the other meteorological institutions that may be specially interested in the matter."

During this meeting it was announced that M. Mascart had been elected president, and Prof. Hildebrandsson secretary, to the committee, and that the following commissions had been renewed:—Magnetic commission, president, General Rykatcheff (St. Petersburg); aëronautical commission, president, Prof. Hergesell (Strasburg); solar commission, president, Sir Norman Lockyer (London); commission on radiation, president, Prof. Ångström (Upsala). After thanking the reporters of the various commissions for their reports, the president declared the session at Innsbruck to be at an end.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD. The Vice-Chancellor has appointed Lord Curzon of Kedleston to be Romanes lecturer for 1906.

The following elections have been made to the University mathematical scholarships:—to the senior scholarship, A. Holden (Balliol College); to the junior scholarship, A. V. Billen (University College); to the exhibition, J. Hodgkinson (Jesus College).

G. E. Beaumont (Magdalen College School) has been elected to a natural science scholarship at University College.

Scholarship examinations in natural science will take place on March 13 at Keble College, and on April 24 at Merton College, New College, and Corpus Christi College.

CAMBRIDGE.—The board of biology and geology has reported to the Senate on the disposition of its share of the Gordon Wigan fund, which amounts to about 150*l*. The following assignment has been made for 1905 and following years:—(*a*) A grant of 50*l*. a year to Dr. D. Sharp, for a period of five years (1905–9), or such part of it during which he holds the curatorship in zoology; (*b*) a grant of 50*l*. out of the income for 1905 to Prof. Hughes, to enable Mr. E. A. Arber to continue his researches into the stratigraphical and geographical distribution of fossil plants; (*c*) the balance of the fund for 1905, and a grant of 50*l*. for each of the years 1906 and 1907, to Mr. A. C. Seward, to enable the botanic garden syndicate to offer greater facilities for plant-breeding experiments. The same board strongly recommends that the agreement between the University and Dr. Dohrn, director of the zoological station at Naples, be renewed for a further period of five years, by the payment to him of 100*l*. per annum out of the Worts travelling bachelors' fund, such period to date from Michaelmas, 1906.

Mr. D. G. Hogarth will lecture on "Geographical Conditions affecting Population in the East Mediterranean Lands" in the Sedgwick Museum on Tuesday, February 20, for the board of geographical studies, and Dr. Hans Gadow is to lecture to-day before the Antiquarian Society on "Aztec Civilisation and its Origin."

THE council of the University of Liverpool at a meeting held on January 23 passed the following resolution:—"That on the recommendation of the Senate a readership in ethnography be instituted in recognition of the scholarship of H. O. Forbes, LL.D., director of the Public Museums of Liverpool, and that Dr. Forbes be appointed to the said readership."

IT is announced in *Science* that Mr. N. W. Harris, of Chicago, has presented 5000*l*. to North-western University, to be used as an endowment for an annual series of lectures to be delivered by some distinguished man, not a professor of the university, upon the results of his own investigations in scientific, literary, economical, or theological problems. From the same source we learn that by the will of Andrew J. Dotger, of South Orange, N.J., the Tuskegee Normal and Industrial Institute will, at the death of the testator's wife, receive the residuary estate, said to be about 100,000*l*.

IN an address delivered to the Manchester section of the Society of Chemical Industry, Dr. G. H. Bailey, as chairman of the section, dealt with the question of higher education and chemical industry, pleading for more cooperation between manufacturers and teachers. If success is to be achieved in the chemical industries of this country, Dr. Bailey considers that there must be a great change in the curriculum hitherto adopted in our universities and colleges; moreover, "a satisfactory curriculum can only be assured by a more intimate association of the teaching authorities, whoever they may be, and the leaders of industry." In considering the present state of English industry and the methods necessary to ensure its prosperity, Dr. Bailey remarks:—"progress in manufacture must indeed be regarded as a safeguard to stability, far more potent than any political or economic device for the protection of interests, and that nation must succeed in industry, which keeps this clearly in view and possesses the talent wherewith to meet the ever changing demands made upon it."

VISCOUNT HAYASHI, the Japanese Ambassador, distributed the prizes to the successful students of the Northern Polytechnic Institute, Holloway, on January 25. In the course of a subsequent address, he said that scientific research made such strides in the past century that it is no exaggeration to assert that the present is the age of practical application in every phase of modern life. Therefore there is nothing more important in a national system of secular education than institutions which keep abreast with the stride of science. Viscount Hayashi explained then that he took part in the administration of the technical college in Tokio. That college was established some thirty years ago with the help of many British professors and men of science whose names are well known in Europe, and from it thousands of students have been sent out to take part in engineering and other works necessitating the scientific application of the mechanical arts. Japan owes very much to that great educational work, and Viscount Hayashi said his people felt grateful for the assistance which Great Britain had given in this department.

THE London County Council School of Marine Engineering at Poplar, which was described in NATURE for October 19, 1905 (vol. lxxii. p. 623), was opened on January 24 by Sir William Collins, M.P. An address was delivered by Sir William White, K.C.B., who expressed a favourable opinion of the arrangements, equipment, and course of study provided in the new institute. He went on to describe the remarkable results attained during the last twenty years by a modest educational scheme which he

had conducted on behalf of the Shipwrights' Company of the City of London. Before 1888 there was no evening class in the Port of London where young men could obtain instruction in the science of shipbuilding. The Shipwrights' Company then undertook to establish and assist evening classes, which have been since carried out successfully and without a break in various parts of the East End. In these classes hundreds of young men have received valuable teaching, and the results have surpassed expectation; many of the students of the evening classes have proved themselves capable of taking the highest training in naval architecture at the Royal Naval College at Greenwich, and elsewhere, and not a few have secured positions of importance and responsibility in the Admiralty service, under the Board of Trade, Lloyd's Register of Shipping, and in private shipbuilding establishments. This object-lesson of what can be done with moderate expenditure, under careful and personal supervision, gives every reason for anticipating much greater benefits from the new institute with its ample means and adequate provision. Sir William White concluded by remarking that technical education for the rank and file as well as for the leaders and captains of industry is of great importance, and in providing the new school and equipping it on so generous a scale the London County Council has shown great wisdom as well as great liberality.

MEN of science have long urged the necessity for the introduction of scientific methods of inquiry and procedure into national administration, and their consistent advocacy culminated recently in the inauguration of the British Science Guild with the primary object of familiarising statesmen and others with the scientific spirit. The first president of the new guild, Mr. Haldane, is the Secretary of State for War in the new Government, and his speech on January 27 at a banquet of the Edinburgh University Liberal Association may well fill men of science with hope that a new era is near in which ideas and the results of scientific research will be taken into account in legislation and administration. Mr. Haldane insisted that national prosperity is not wholly a matter of fiscal policy. Answering the question, Is all well with us? he replied in the negative, because we are lacking in the ideas which science alone can give us, and consequently are lacking in the organisation of our industries. Knowledge, the expert, the spirit of science and organisation to permeate our people, our manufacturers, and workmen alike are all wanted. One of the ways in which the universities can assist the nation is in this direction. Mr. Haldane said his impression is that the Army would be the better for more help from the universities than it had been able to take from them. There are too few officers of the right sort, the thinking sort, like the men in the Engineers and in the Artillery, but of whom there are too few in the Cavalry and the Line. Mr. Haldane thinks he sees the beginning of a movement of this kind; and he hopes the university men will play a distinguished part in the future in obtaining that which is absolutely essential in making the Army an efficient army—a supply of scientifically minded officers and soldiers. The splendid fighting quality in the field which has distinguished the Army in the past, the quickness of eye that is born and that does not come is needed; but with it and behind it, whether in the hands of the general staff or of the commander himself, there must be a knowledge that can only come of the hard and patient discipline of the spirit.

THE cooperation of employers in the technical training of apprentices was a subject of discussion at the annual meeting of the Association of Technical Institutions held last week. A report upon this subject was issued recently by the association, and some of the results of the inquiry were stated in NATURE of December 21, 1905 (p. 188). In a contribution to the discussion, Prof. W. Ripper remarked that his own observation and experience has led him to believe that the unsympathetic attitude towards technical education which used to be so common among foremen and employers in this country is undergoing a change. The apathy and indifference towards educational improvement so general among apprentices and young people will be largely removed when they are made to realise that there is, as a rule, no promotion for them unless they are able to show that they possess educational as well as practical fitness for such promotion. This method of promotion is the one exclusively adopted in the Government dockyards, and the results of it have without doubt been highly satisfactory. In the race for commercial supremacy England, America, and Germany are each, probably, equally well equipped with the most up-to-date machinery and appliances. But these are tools merely. For the real element of success, for the intelligence and virility behind the tools, we depend alone upon the quality of the individual men from top to bottom of the industrial army; and especially do we depend upon the quality of the men at the top—the leaders—whose character, ability, foresight, judgment, power of organisation, and power of inspiration must ultimately determine the degree of success of the efforts of the whole. At present there is too often no connection whatever between the works and the technical school, no knowledge on the part of the employer of the quality of the youths in the colleges, who are available for suitable employment, and, on the other hand, no opportunity on the part of the youths to show possible employers what qualifications they possess, and what claim they have to recognition over the youth who has received no training. A closer relationship between employers and the teachers in technical institutions is therefore demanded in the interests both of public efficiency and of private well-being. In the discussion which followed the reading of Prof. Ripper's paper, Prof. Wertheimer said there is no doubt a steady, if not rapid, improvement taking place year by year. Firms—and the best firms, too—are recognising the desirability of getting into their employ young people whose intelligence has already been trained.

SIR WILLIAM ANSON delivered an address as president of the Association of Technical Institutions, at the annual meeting of the association held last week. In the course of his remarks, he said that the subject which most exercises both the local authorities and the Board of Education is the coordination of the studies which make up our system of education, and especially coordination in such a manner as to give to our technical institutions their proper place and to secure for them their utmost utility. There is no subject more intimately connected with the welfare of the people and the prosperity of our industries. We have paid somewhat dearly for our neglect of science in the past, and not merely for neglect of science, but of any conception of education which can be regarded as scientific or even as systematic. There is one form of error which touches more nearly the elementary schools. We have founded technical institutes, have multiplied libraries and laboratories, but have not taken pains to ensure that those to whom this instruction is offered are capable of taking advantage of it. Time and money are wasted in endeavouring to impart technical instruction to students who have forgotten such elementary mathematics as they ever knew, and who are unable to express their knowledge in their own language in an intelligible form. Everyone ought to know something of science, and everyone would be the better for learning the practical application of some branch of science. But we want the students in technical institutions to come to them able to take advantage of the opportunities which they afford, and not only this, but able to carry forward knowledge which they acquire; not merely to learn something and go away with no idea or intention of following up the instruction which they have received. An educational system may be devised in which all the parts are symmetrically fitted together, in which science pure, and science applied, language, literature, and history are all given their due place, and every arrangement made for the student to pass through courses appropriate to him under teachers fully qualified for their work. But even if these educational ideals are realised, it may be doubted whether we shall get what is wanted until there comes into existence a more widely diffused belief in education, in the value of a trained intelligence as well as of particular information, a belief that experience acquired with knowledge, and knowledge applied with intelligence, are better than that mere experience which is described in the common phrase "rule of thumb." As Sir John Wolfe Barry had said, "We want to see in Great Britain the

man of science installed in his laboratory in all important manufactories and encouraged to help in their development." Great employers have it in their power to advance the education of the people all along the line. Technical instruction in all its stages is a practical thing; and when it is realised that employers appreciate the instructed and intelligent student, then parents will begin to see that education has a practical value. The educational gospel should be "Believe, believe," not only or chiefly in machinery, in a curriculum, a laboratory, a library, but in the value of knowledge, of intelligence, of training, and when we have made this belief widespread an important step will have been taken toward the education of our people.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 14, 1905.—"Report on the Psychology and Sociology of the Todas and other Indian Tribes." By Dr. W. H. R. **Rivers.** Communicated by the Secretaries of the Royal Society.

An abstract of observations made chiefly on the Todas of the Nilgiri Hills. The psychological work deals chiefly with the senses, in only two of which is there evidence of decided difference between Todas and Englishmen. The former were less sensitive to pain, and showed certain deficiencies in the colour-sense, especially in the degree of relative sensibility to red and blue, a low degree of sensibility for blue being associated with defective nomenclature for that colour. Definite colour-blindness was found in 12 per cent. of the males, a frequency higher than has been recorded in any other race. Quantitative observations were made on two visual illusions, one of which, that of compared horizontal and vertical lines, was distinctly more pronounced in the Todas, while the other, the Müller-Lyer illusion, was present in a slighter degree. This difference is believed to depend on the difference in nature of the two illusions. Especial attention was paid to the variability of the individuals subjected to the tests, and it is shown that there is some evidence of correlation between the degree of general intellectual development and certain simple mental activities which can be tested by experimental methods.

The sociology of the Todas was studied by means of the genealogical method, and was found to have many points of resemblance with that of Malabar, and the view is advanced that the Todas at one time inhabited that district and are probably of the same race as the present inhabitants of Malabar, the Nairs and Nambutiris. A detailed record was obtained of the elaborate religious ritual of the Todas, and evidence is given that this religion has undergone degenerative changes. It is suggested that this is part of the general disappearance of a higher culture which the Todas brought with them to the Nilgiri Hills.

"On the Spectrum of the Spontaneous Luminous Radiation of Radium. Part IV. Extension of the Glow." By Sir William **Huggins,** K.C.B., O.M., F.R.S., and Lady **Huggins.**

In our second paper [1] we suggest "whether the β rays, which are analogous to the kathode corpuscles, may not be mainly operative in exciting the radium glow. On this surmise it would be reasonable to expect some little extension of the glow outside the limit of the solid radium itself. We are unable to detect any halo of luminosity outside the limit of the solid radium bromide; the glow appears to end with sudden abruptness at the boundary surface of the radium." We omitted to state that this conclusion was arrived at by eye observations. The radium was observed in the dark with a lens, and with a low-power microscope.

The earlier photographs of the spectrum of the glow were taken, for the purpose of comparison spectra, with the height of the slit reduced by shutters so as to be within the width of the exposed radium bromide, and, therefore, these photographs would not show whether the bright bands of nitrogen extend into the air beyond the radium. Subsequently photographs were taken with the whole height of the slit, and on these we find that all the bands of nitrogen do extend to some little distance outside the radium salt. Our attention at the time being directed to other phenomena of the glow, we did not examine the photographs to see if the nitrogen bands extended beyond the radium.

[1] *Roy. Soc. Proc.*, vol. lxxii., p. 410 (1903).

In a paper, dated August 22, 1905, F. Himstedt and G. Meyer [1] state that in their photographs of the spectrum of $RaBr_2$, the four nitrogen bands, 3577, 3371, about 3300, and 3159, extend beyond the radium salt, while the other less refrangible bands are not traceable outside the radium. In our photographs all the nitrogen bands project beyond the radium salt, the relative distance to which the extension can be detected in the case of each band being, as might be expected, in proportion to the strength of the impression of that band upon the photographic plate.

B. Walter and R. Pohl, in a paper dated September, 1905,[2] give an account of experiments made with the help of screens, which show that for a distance of up to about 2 cm. the air surrounding radium bromide has an action on a photographic plate.

On re-examining an early photograph, taken in 1903 for another purpose, which is described in our second paper,[3] in which the $RaBr_2$ was enclosed in a very narrow tube of thin glass, we find that the bands of nitrogen, which are strong within the tube, show no trace of extension on the plate beyond the tube. The exposure of this plate was seven days.

This experiment, which we have repeated recently with an exposure of fourteen days, shows that the luminosity of nitrogen in the near neighbourhood of radium bromide is not due to the kathode-like β radiation, for this passes freely through glass.

Two explanations may be suggested: first, that the active cause is the α rays; [4] or secondly, that the nitrogen molecules which encounter those molecules of the radium which are undergoing active changes are broken up into ions, which are projected outwards, and give rise to the glow of luminous nitrogen.[5]

Royal Astronomical Society, January 12.—Mr. W. H Maw, president, in the chair.—Photograph of comet *c*, 1905, taken at the Royal Observatory, Greenwich, on January 8: **Astronomer Royal.** The photograph showed the comet with a bright nucleus and a faint, straight tail extending about 2°. It was hoped that further photographs would be obtained after the comet had passed the sun.—The ring nebula in Lyra: E. E. **Barnard.** A careful series of measures of the positions of the stars about the nebula appeared to show that the star in the centre of the ring had neither proper motion nor parallax.—Mean areas and heliographic latitudes of sun-spots in the year 1904: **Astronomer Royal.**—Photographic reproduction of *réseaux* for star photography: H. **Bourget.** Specimens of the *réseaux* were shown on the screen.—Report on observations of Jupiter at Trincomali, Ceylon, 1904–5: Major P. B. **Molesworth.** Special attention was directed to the remarkable movement of the south tropical dark area in the neighbourhood of the great red spot. The motion of the area across the red spot bay was so rapid that it seemed necessary to assign some cause other than the actual transference of matter.—Measures of wide double stars: Rev. T. E. **Espin.**—Action of the wood of the dark slide upon photographic plates: Prof. H. H. **Turner.** The plates were negatives of the solar eclipse taken at Aswan by Mr. J. H. Reynolds, which were greatly injured by strong impressions of the grain of the wood of the dark slides in which they were placed after exposure. The same had occurred to Dr. Copeland's plates taken in 1898. It was stated that the wood of Mr. Reynolds's slides was very old, and various suggestions were made, but the real cause of this effect upon the plates still appeared obscure.—Lunar nomenclature: W. **Goodacre.**—Measures of the lunar crater Mösting A made at the Royal Observatory, Greenwich: **Astronomer Royal.**

[1] F. Himsted and G. Meyer, *Ber d. Nat. Gesells. Freiberg* vol. xvi. pp. 13–17.
[2] B Walter and R. Pohl, *Ann. de Phys.*, vol. xviii., p. 406.
[3] *Roy. Soc. Proc.*, vol. lxxii., p. 412.
[4] B. Walter, July, 1905, showed by means of absorption screens that the radiation from radio-tellurium can produce the ultra-violet light of nitrogen (*Ann. d. Phys*, vol. xvii., p. 367).
[5] The experiments described in our last paper showed that probably the β rays are not the operative cause of the nitrogen glow (*Roy. Soc. Proc.*, vol. lxxvi., p. 488).

Paris.

Academy of Sciences, January 15.—M. H. Poincaré in the chair.—The landing of aëroplanes: Bouquet **de la Grye.** A plan of arresting an aëroplane, and capable of keeping it horizontal during its descent, is described. It has been found to work in experiments on the small scale.—The n-rays: M. **Mascart** (see p. 325).—The influence of the reaction of the medium on the activity of amylase and on the composition of saccharified starch: L. **Maquenne** and Eug. **Roux.** The effect of the acidity or alkalinity of the solution on the hydrolysis of starch by malt has been recognised by other workers, without, however, the effect being quantitatively determined. The author shows that phenolphthalein is an unsuitable indicator to use for these experiments, methyl orange being better. He has found that for a rapid hydrolysis it is first necessary to neutralise the alkali of the starch, then to add to the malt a quantity of sulphuric acid equal to about 0·4 of that which would be required to neutralise it completely. Not only can the rate of hydrolysis be greatly increased by this treatment, but the proportion of maltose formed is also raised about 10 per cent. to 15 per cent.—Observations on the subject of the group C(OH) of the tertiary alcohols: Louis **Henry.** Tertiary butyl alcohol is converted by aqueous fuming hydrochloric acid into the corresponding chloride with great ease; by the substitution of the hydrogen atoms of the methyl groups by other elements the action of the hydrochloric acid is modified, the velocity of the reaction and amount of the ester formed being reduced, or the action altogether prevented. In the present paper the effects produced by the introduction of chlorine, cyanogen, and oxygen are discussed.—Some integrals of partial differential equations: E. **Goursat.**—A family of conjugated networks with the same congruence: E. **Merlin.**—The impossibility of negative waves of shock in gases: Gyözö **Zemplén.** A reply to the criticisms of P. Duhem on a former note on the same subject.—The conditions of establishment and application of progressive damping for the oscillations of road vehicles: A. **Krebs.** It is shown by a theoretical analysis of the problem that the friction of ordinary carriage springs ceases to be efficient when the sudden change of level is more than 2 cm. A new arrangement is described which satisfies the theoretical conditions for greater oscillations, and which has been found to work well in practice.—Photographic experiments on the action of the n-rays on an oscillating spark: C. **Gutton.** If the n-rays are allowed to fall on the primary spark of a Hertzian oscillator, the secondary spark diminishes. The present paper deals with the photographic registration of this effect.—The density of ice: A. **Leduc.** About 108 grams of water were frozen in each of the author's experiments. Well boiled distilled water gave a density of 0·9172, but it was clear that this number was too small, since in the upper part of the density flask small strings of separated air bubbles were visible. By repeatedly melting and freezing in a vacuum, the density was raised to 0·9176, and even in this case there was some evidence of traces of dissolved air. It is pointed out that the usual method of analysing the gases dissolved by water must be inexact, since all gas is not expelled by boiling.—The distribution of electric currents in a network: I. **Révilliod.**—A parhydric valve: J. de Rohan **Chabot.** A description of a new form of valve for preventing the return of water into the vacuum of a filter pump.—Correction to a note on the saline oxide of nickel: H. **Baubigny.**—The silicide of copper, and a new mode of formation of silicon soluble in hydrofluoric acid: Paul **Lebeau.** When the amount of silicon in a copper silicon mixture is raised above 10 per cent., a metallographic examination shows the presence of free silicon.—A silicide of thorium: O. **Hönigschmid.** This has been prepared by heating together a mixture of aluminium, potassium fluosilicate, and the double fluoride of thorium and potassium; the excess of aluminium is removed by treatment with potash solutions. The compound isolated, the chemical and physical properties of which are given, has the composition $ThSi_2$. The diazo-derivatives of the diamines: Léo **Vignon.**—The estimation of carbon monoxide in air by iodic anhydride: Albert **Lévy** and A. **Pécoul.** Although acetylene reacts with iodic anhydride, it does not interfere with the estimation of minute amounts of carbon monoxide in air, since a mixture of 1 part of acetylene in 10,000 parts of air gives no iodine.—The estimation of small quantities of chloroform in air and in blood or in aqueous solution: Maurice **Nicloux.** A combination of the methods of Dumas (the action of alcoholic potash on chloroform) and Mohr (chlorine titration in presence of a chromate).—The combustion of acetylene by oxygen: Paul **Mauricheau-Beaupré.** An examination of the products of combustion of the oxy-acetylenic blow-pipe flame showed that oxides of nitrogen and ozone were present, but no trace of carbon monoxide.—The direct proportionality between the cryoscopic point of a mineral water of the bicarbonate class and the composition of this water expressed as anhydrous monocarbonate: Lucien **Graux.** The half-bound carbonic acid is without effect on the freezing point.—Mixed crystals of alkaline nitrates: Fréd. **Wallerant.**—The alkaline rocks in the neighbourhood of Evisa, Corsica: M. **Deprat.**—The yield of urine: Henri **Lamy** and André **Mayer.** The vitelline of the egg: L. **Hugounenq.**—New researches on the oxidations produced by animal tissues in the presence of ferrous salts: F. **Battelli** and Mlle. L. **Stern.** Examples of the analogy between the oxidations produced by hydrogen peroxide in presence of ferrous sulphate and by animal extracts in presence of the same salt. The anomalous behaviour of the proteolysis produced by papaine: C. **Delezenne,** H. **Mouton,** and E. **Pozerski.**—The whitening of wheaten flour: E. **Fleurent.** The oxides of nitrogen are more favourable than ozone, the latter giving an objectionable smell to the flour.—Geology of the Peloponnesus: Ph. **Négris.**—An ancient volcanic chain to the N.W. of the Puys chain: Ph. **Glangeaud.**—Magnetic observations made at Sfax, Tunis, on the occasion of the total eclipse of the sun of August 30, 1905: M. **Dehalu.**

January 22.—M. H. Poincaré in the chair.—The boiling of osmium, ruthenium, platinum, palladium, iridium, and rhodium: Henri **Moissan** (see p. 325).—The origin of the idea of solid solutions: Lecoq **de Boisbaudran.** A claim for priority in the idea of solid solution.—Glycuronic acid in the blood corpuscles: R. **Lépine** and M. **Boulud.** The authors point out the liability of changes in the glycuronic acid contents of the blood after it has left the blood-vessel, and the precautions necessary to avoid such change.—A theorem relating to the second differentials of the potential of an attracting volume: A. **Korn.**—Elliptical polarisation produced by mixed liquids: J. **Chaudier.**—Some new magneto-optical properties of colloidal solutions of oxide of iron: A. **Cotton** and H. **Mouton.**—The kathodic phosphorescence of europium: G. **Urbain.** Certain differences in the spectra observed might be interpreted as being due to two elements in europium, or possibly to purely physical causes independent of the elementary complexity. Further experiments will be made to elucidate this point.—Mixtures of antimony and tellurium, antimony and selenium, and the cryoscopic constant of antimony: H. **Pélabon.**—Methoxytrichloropentanol 1 : 5 : 4 and α-trichloromethyltetrahydrofurfurane: J. L. **Hamonet.**—Acetylenic amides and nitriles: Ch. **Moureu** and I. **Lazennec.** A general method for preparing the amide $R-C\equiv C-CONH_2$ and the corresponding nitriles is given.—Glycidic condensation of the aldehydes with α-chloropropionic ester: Georges **Darzens.**—The acyclic vinyl and β-chloroethyl ketones: E. E. **Blaise** and M. **Maire.**—A crystalline modification stable in two intervals of temperature: Fréd. **Wallerant.**—The influence of the colouring matters in a mother liquid on the form of the crystals deposited: P. **Gaubert.** During their growth, crystals of phthalic acid can absorb a certain quantity of foreign material which exercises an influence on their form and size. The different faces are not penetrated by the foreign substance with the same facility. The actual amounts of the colouring matters included were small, 1 170th for methylene blue and less for other substances.—The mechanism of the fall of certain terminal buds: A. **Tison.**—A new genus of fungus from British East Africa: P. **Hariot** and N. **Patouillard.**—The variations of phosphoric acid and nitrogen in the juices of the leaves of certain plants: G. **André.** In an annual plant, a

part of the phosphoric acid leaves the leaf and goes towards the ovule in the state of a soluble mineral phosphate, whilst another part is displaced from its state of combination with nitrogenous material.—The properties of colloids and the dynamic interpretation of cell division: Angel **Gallardo.**—On *Leposphilus labrei* and on the family of the Philichthydæ: A. **Quidor.**—The action of extract of the interstitial gland of the testicle on the development of the skeleton and on the genital organs: P. **Bouin** and P. **Ancel.**—Experimental researches on the proportions of chloroform contained in the organism during chloroform anæsthesia: J. **Tissot.**—The action of sulphate of hordenine on the circulation. L. **Camus.** With large doses there is an increase of the blood pressure accompanied with modifications in the rhythm and amplitude of the pulsations; small doses have little effect on the blood pressure, but give rise to important changes in the number and amplitude of the pulsations.—The reconstitution of an ancient Oligocene lake on the north side of the massif of Mont Doré: Ph. **Glangeaud.**—New observations on the geology of the Sahara: René **Chudeau.**—On the formation of the network of the reticulated Nummulites: Jean **Boussac.**—The oceanic circulation: MM. **Thoulet** and **Chevallier.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—On the Filtration of Crystalloids and Colloids through Gelatin, with Special Reference to the Behaviour of Hæmolysins: J. A. Craw.—Chemical Action of *Bacillus lactis aerogenes* (Escherich) on Glucose and Mannitol: Production of 2: 3-Butyleneglycol and Acetylmethylcarbinol: Dr. A. Harden and G. S. Walpole. On Voges and Proskauer's Reaction for Certain Bacteria: Dr. A. Harden.—The Quantitative Estimation of Small Quantities of Nickel in Organic Substances: H. W. Armit and Dr. A. Harden.—The Alcoholic Ferment of Yeast Juice: Dr. A. Harden and W. J. Young.—On the Function of Silica in the Nutrition of Cereals. Part I.: A. D. Hall and C. G. T. Morison.—On the Origin of the Sertoli or Foot Cells of the Testis: C. E. Walker and Miss A. L. Embleton.—Studies on Enzyme Action—Lipase: Maurice Nicloux.—A Further Communication on the Specificity and Action in Vitro of Gastrotoxin: Dr. C. Bolton.

CHEMICAL SOCIETY, at 8.30.—Hydroxylamine-$\alpha\beta$-disulphonates (Structural Isomerides of Hydroxyamino-sulphates or Hydroxylamine-$\beta\beta$-disulphonates): T. Haga.—Studies in the Camphane Series. Part XXI. Benzenediazo-ψ-Semicarbazino-camphor and its Derivatives: M. O. Forster.—The Relation between Absorption Spectra and Chemical Constitution. Part I. The Chemical Reactivity of the Carbonyl Group: A. W. Stewart and E. C. C. Baly.—(1) The Relation between Absorption Spectra and Chemical Constitution. Part II. The Quinones and α-Diketones; (2) The Relation between Absorption Spectra and Chemical Constitution. Part III. The Nitranilines and the Nitrophenols: E. C. C. Baly and A. W. Stewart.—The Action of Light on Benzylidenephenylhydrazine: F. D. Chattaway.—The Union of Chlorine and Hydrogen: D. L. Chapman and C. H. Burgess.—Note on the Molecular Weight of Adrenaline: G. Barger and A. J. Ewins.—The Critical Temperature and Value of ML/O of Some Carbon Compounds: J. Campbell Brown.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Destructor Bye-products: F. L. Watson.

LINNEAN SOCIETY, at 8.—The Percy Sladen Trust Expedition to the Indian Ocean in H.M.S. *Sealark*: J. Stanley Gardiner.

SOCIETY OF ARTS, at 8.—Howard Lecture: High Speed Electric Machinery, with Special Reference to Steam-Turbine Machines: Prof. S. P. Thompson, F.R.S.

FRIDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 9.—The Electric Production of Nitrates from the Atmosphere: Prof. S. P. Thompson, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting. Presidential Address: The Study of Fossil Fishes: Dr. A. Smith Woodward, F.R.S.

SATURDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 3.—Advances in Microscopy: J. W. Gordon.

MONDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 5.—General Monthly Meeting.

SOCIETY OF ARTS, at 8.—Modern Warships: Sir William White, K.C.B., F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Loss of Nitre in the Chamber Process. Part II.: J. K. H. Inglis.

VICTORIA INSTITUTE, at 4.30.—On Biological Changes in Geological Time: Prof. J. Logan Lobley.

TUESDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 5.—Food and Nutrition: Prof. W. Stirling.

SOCIETY OF ARTS, at 4.30.—Imperial Immigration: O. C. Beale.

ZOOLOGICAL SOCIETY, at 8.30.—On Trichorhiza, a New Hydroid Genus: E. S. Russell.—Notes on the Histology and Physiology of the Placenta in Ungulata; Dr. J. W. Jenkinson.—Description of a New Fly of the Family Tabanidæ: Miss G. Ricardo.—A List of the Mammals obtained by Messrs. R. B. Woosnam and R. E. Dent in Bechuanaland: H. Schwann.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion*: The Railway-Gauges of India: F. R. Upcott.

WEDNESDAY, FEBRUARY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—President's Annual Address, followed by Ordinary Meeting.—Note on Dutch Cheese: C. H. Cribb.—The Assay of Mercury Ores: G. T. Holloway.—The Purification of Zinc and Hydrochloric Acid: Dr. L. T. Thorne and E. H. Jeffers.—The Facing of Rice: C. H. Cribb and P. A. E. Richards.

GEOLOGICAL SOCIETY, at 8.—On the Carboniferous Limestone (Avonian) of the Mendip Area (Somerset), with Especial Reference to the Palæontological Sequence: T. F. Sibley.—The Igneous Rocks Associated with the Old Red Sandstone of the Mendips: Prof. S. H. Reynolds.

SOCIETY OF ARTS, at 8.—Progress in Electric Lighting: Leon Gaster.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Roche's Ellipsoids and on Allied Problems Relating to Satellites: Sir George H. Darwin, K.C.B., F.R.S.—On Periodicities in Sun spots: Prof. A. Schuster, F.R.S.—Explosions of Coal-Gas and Air: Prof. B. Hopkinson.—Polarisation in Secondary Röntgen Radiation: C. G. Barkla.—Constants of Explosion of Cordite and of Modified Cordite: Robert Robertson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering: F. W. Carter (*Conclusion of Discussion*).—Crane Motors and Controllers: C. W. Hill.

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution: Benjamin Kidd.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Eclipse Problems and Observations: H. F. Newall, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30 (Research Department).—The Ruins of Rhodesia and the Probable Date of Outside Intrusions in East Africa: Discussion to be opened by D. Randall MacIver.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—On Pearl-Oyster Culture and Pearl Fishing: T. H. Haynes.—Irish Molluscs and their Habitats: R. J. Welch.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Driving at the Locomotive Works of the North London Railway: R. H. Mackie.

SATURDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 3.—Advances in Microscopy: J. W. Gordon.

MONDAY, FEBRUARY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of the Spanish Armada: Rev. W. Spotswood Green.

CONTENTS.

THURSDAY, FEBRUARY 8, 1906.

A NEW INTEGRAL CALCULUS.

Integral Calculus for Beginners. By Alfred Lodge, M.A. Pp. xiii+203. (London: George Bell and Sons, 1905.) Price 4*s.* 6*d.*

"THIS is a sequel to the author's 'Differential Calculus,' and is intended for students of physics and mechanics who require a good working knowledge of integration and its more simple applications." Such is the claim put forward by Prof. Lodge in his preface. We naturally expect a book in which simple useful applications figure more prominently than lengthy theoretical investigations, and in this we are not disappointed. Moreover, a number of interesting features strike us as being particularly good, although a few others are capable of improvement.

The first of the good features is the insertion of the integration constant C in the elementary worked-out examples on integration. Its omission frequently leads a beginner astray. Another feature possessing many advantages is that the chapter on rational fractions is reduced to a minimum. The process of integrating a rational fraction with a denominator of high degree is not often required in actual practice. Moreover, the graph of such a fraction has infinite branches corresponding to the real factors of the denominator, so that unless the areas of these infinite branches are carefully discussed, by introducing the notion of the "principal value" of a definite integral, the result only enables us to find the areas of limited portions of the curves, for which approximate methods of quadrature would in many cases suffice. On the other hand, the mode of introducing the connection between integration and summation—a point on which Prof. Lodge rightly lays special stress (§§ 2, 43, 48)—will probably be regarded by most readers as not so satisfactory as it might be. Thus, to go no further, a relation on p. 4 is stated to be true to the first order which on p. 62 is shown to contain an error of the first order. This is the greater pity as the investigation of § 48 would, with the addition of a couple of lines, contain all that is necessary for a rigorous graphical proof, far shorter than that given in § 2; we hope this point will receive attention in future editions.

In reading the sections dealing with Simpson's rule and its modifications, one is surprised at the conservatism that prevails in the retention of a formula in which odd and even ordinates have unequal weight —a conservatism quite independent of the present book. When it is recollected that cutting off the first and last strips of a curvilinear area reverses the weights of the ordinates it will be seen easily that the trapezoidal rule, modified by suitable corrections for the two ends, may be made to give results quite as accurate as those of Simpson's rule.

Under applications of the calculus, we find areas, centres of mass, volumes and surfaces of revolution, and moments of inertia with especial reference to plane areas and their centres of pressure. The sections on differential equations contain what has for some time past been regarded as a standard elementary course on the subject, namely, the simpler equations of the first order and linear equations with constant coefficients. The study of the first integral of the equation $d^2y/dx^2=f(y)$ in connection with its kinematic interpretation, and the discussion of small oscillations in connection with the equation of harmonic motion, are good features. Finally, the chapter on the Gamma function has given Prof. Lodge an opportunity of saying something he wanted to say, and of saying it in his own way instead of cutting or drying it down to the requirements of a syllabus. It contains an interesting discussion of the extension of the conception of a factorial to negative and fractional arguments. It is much to be hoped that this chapter will encourage other writers of text-books to launch out into something new and original. This might to some extent help to save English mathematical teaching from sinking down to a uniform dead level of mediocrity, reminding one of an open, barren *veldt,* in which all the smaller hills have been levelled down by the steam-roller of the examination and the syllabus, and all high eminences have crumbled to the ground as a result of the starvation salaries paid to really competent mathematical teachers.

G. H. Bryan.

[Since the above was written I have had some correspondence with Prof. Lodge quite independently of the present review. The treatment of the summation of infinitesimals contemplated by him in the articles criticised above may be stated more clearly somewhat as follows:—Let $y=f(x)$, and let x increase from a to b by a series of increments dx. Then if dy denote the corresponding increment of y, the sum of the increments dy is *exactly* equal to $f(b)-f(a)$. Moreover, the "exact differential" dy becomes equal to the "differential product" $f'(x)dx$ when dx is infinitesimal, and *under this condition* we may put $f(b)-f(a)$, equal also to the sum of the differential products $f'(x)dx$. Also in all practical applications Prof. Lodge contends that what we really want is the sum of the exact differentials dy rather than the sum of the corresponding differential products $f'(x)dx$. This contention I believe to be correct, and if Prof. Lodge can re-write the articles once more —for he says that he has already repeatedly re-written them—and make it more clear that he is not merely giving an inaccurate reproduction of Todhunter's rigorous proof, but something quite different, his treatment may be made one of the many valuable features of his book. The method interests me greatly, and appears to be of sufficient general interest to justify the present explanatory note.—G. H. B.]

STIMULUS AND MEMORY.

Die Mneme als erhaltendes Prinzip im Wechsel des organischen Geschehens. By Richard Semon. Pp. xiv+353. (Leipzig: Wilhelm Engelmann, 1905.) Price 6s. net.

LITTLE as it may appear from the title, this work is really an inquiry into some of the remoter effects of stimulation. Thus, every stimulus applied to organic substance—whether that substance be nervous, or not nervously differentiated—produces not only its appropriate reaction, but also an altered condition of the substance itself, so that even when the immediate effect of the stimulation has subsided, the second "condition of indifference" is different from the first. The substance may now, for example, readily react to stimuli which before were insufficient to produce any appreciable effect, or it may respond to a stimulus connected only by association with the stimulus usually necessary. It pleases this author to read and group these facts anew, and to apply to them a terminology that will correspond with the novelty of the grouping. Hence he calls the enduring effect of the stimulus an *engramm*; the stimulus is said to operate *engraphically* on the substance, or to produce an engraphic alteration. Again, when stimulus B, differing in quality or quantity from stimulus A, still succeeds with the aid of the *engramm* in producing a reaction appropriate to A, it is said to operate *ecphorically*, or the new state of excitation is said to be produced by the *ecphory* of the *engramm*. Obviously ordinary memory may be brought under this wide class of phenomena, and the author might have used the term memory to describe these facts; but, to avoid misunderstanding, he has chosen the term *mneme* instead. Hence we read of such things as *mnemic* excitation, *e.g.* in the case mentioned above when stimulus B is applied.

The situation is well summed up on p. 89:—

"We recognise the presence of an engramm by the circumstance that for the discharge of the appropriate reaction the appearance of the original unaltered stimulus is no longer necessary, but the appearance either of the original stimulus altered quantitatively or qualitatively, or of a stimulus which works ecphorically on an associated engramm, or the expiration of a definite period of time (chronogenous ecphory), or finally the appearance of a definite phase of development in the continuous series of successive generations (phasogenous ecphory)."

Herr Semon on these lines proceeds to discuss the facts of acclimatisation and instinct, the inheritance of acquired characteristics, and the like, and to translate them into his peculiar language. Thus, when according to Mr. Claypole (as reported by Prof. Lloyd Morgan) young ostriches hatched in an incubator pick up food thrown before them only after someone has "dabbed" with his finger on the ground in their presence, our author's interpretation is that we have here the ecphory of an inherited engramm, an engramm the appropriate reaction of which is pecking; the ecphoric stimulus in this case is the return of the primary stimulus (pecking on the part of the mother hen) altered to some extent qualitatively.

The limits of space forbid a full account or discussion of many interesting questions raised by Herr Semon. In the second part of the book he deals with the mutual relations of engramms, their localisation, the mnemic conditions of excitation, and mnemic homophony. By mnemic homophony is meant "the process by which mnemic excitation and fresh original excitation are, so to speak, made to coincide, and by which each disagreement between the two produces a perceptive reaction." The third part discusses the reality of mnemic processes in "ontogenesis." In the fourth the author deals with various objections, and claims for *Mneme* that it is a necessary preservative principle which protects the transformations continually produced by the external world. He claims, also, that it helps us to an understanding of the law of which Haeckel is the unwearying exponent, viz. that the individual passes through the same stages of development as the whole species to which it belongs.

The author seems a competent reasoner and observer. His work is interesting and suggestive, and opens a fruitful field for discussion.

ECONOMY IN THERMAL POWER PLANTS.

Commercial Economy in Steam and other Thermal Power Plants as Dependent upon Physical Efficiency, Capital Charges, and Working Costs. By Prof. Robert H. Smith. Pp. xxiv+291; with numerous diagrams by H. Malcolm Hodson. (London: Constable and Co., Ltd., 1905.) Price 24s. net.

THE aim of this work is to deduce sufficiently accurate laws for determining the most efficient power plant when all-round economy is taken into account. For this purpose it is necessary to determine a standard of economy, and this is fully discussed in the opening chapter, where a coefficient is defined depending upon the value of the product directly and on the cost and time inversely. The application of this standard to measure the efficiency of production is applied to some examples, and the results of the analyses are considered in detail. After a discussion of the properties of steam, the efficiencies of engines and boilers, and questions of a kindred nature, the author proceeds to deal with the interesting question of the cost of various forms of thermal power plant.

The data for this chapter have been drawn from various sources, principally from makers' catalogues, and are exhibited in graphical form for heat engines by plotting capital or annual costs as ordinates against final cylinder volumes or brake horse-power as abscissæ. In this way very interesting relations are established, which can generally be approximately represented by straight-line laws with sufficient accuracy to form a fair estimate of cost. Thus for Crossley gas engines up to 500 horse-power with Dowson gas producers, the capital cost, including the building, is given as $300+10.8\,T$, where T is the

brake horse-power, while for a corresponding plant using Diesel oil engines the formula is $300+10\,T$. The annual costs for a year of 2700 working hours for these are stated as $200+3.7\,T$ and $110+2.9\,T$ respectively.

Steam engines are treated in like manner; thus in the case of a high-speed tandem compound engine the price is found to be represented by

$$140+0.05\,S-\frac{30,000}{240+S},$$

where S is the final volume of the steam in cubic inches swept out by the low-pressure piston per stroke. Formulæ are developed for boilers in terms of E, the evaporative power in pounds of water per hour, and the pressure, p, in pounds per square inch; thus the price of Lancashire boilers in pounds sterling is expressed by $110+(0.016+0.0003p)E$.

The information brought together in this section has evidently involved much labour, and it should prove extremely useful. The remaining half of the book is devoted to questions involving a considerable acquaintance with thermodynamics, in which the author introduces several new terms, such as "transpower" (p. 155), to signify the time rate of transmission of energy, "dynothermic coefficient" (p. 229), defined as the "ratio of resilience to heat transmission creating it."

Great stress is laid on the irreversible character of practical heat-engine cycles, and the author's views may be judged by his remarks on p. 178, where he says:—

"The conditions of life require rapid work, so that the sooner we give up worshipping reversibility as a fetish worthy to be aspired after and approximated to, the better will we succeed in engineering."

The dependence of maximum economy upon size, indicator diagram, initial and back pressure, working speed, and furnace temperature are all dealt with in detail, and combinations of the best values for effecting economy are considered by graphical methods.

The complex nature of the problems attacked make this part of the book decidedly hard reading, and the difficulty is much increased by the author's notation. The book is well illustrated by diagrams drawn by Mr. H. M. Hodson. E. G. C.

MATERIA MEDICA.

A Text-book of Materia Medica for Students of Medicine. By C. R. Marshall, M.D. Pp. xi+635. (London: J. and A. Churchill, 1905.) Price 10s. 6d. net.

THE compilation of a satisfactory text-book of materia medica is a somewhat difficult task, since the author should, at least in an ideal text-book, be equally conversant with the chemistry of drugs, the botany of those which are of vegetable origin and the therapeutics of all. Dr. Marshall has been singularly successful in preserving in this book an even balance between these various divisions into which the subject naturally falls.

The arrangement adopted, which differs somewhat from those commonly employed in text-books or materia medica, is to be commended. The first portion deals with the inorganic substances used in medicine, then a chapter is devoted to the synthetic products which have of recent years assumed so important a position as remedial agents, including antipyrine, phenacetin, sulphonal, &c., and finally about 300 pages are occupied with the description of drugs of vegetable or animal origin. The method of grouping these drugs is roughly that of the nature of the "active principles" they contain, so that the subject appears as a fairly coherent whole instead of as a set of isolated groups of facts, which is the case when the method of treatment adopted is that of the botanical relationships of the plants from which the drugs are obtained. The descriptions given of the various drugs of vegetable origin are clear, and though concise are sufficient for purposes of recognition, especially when used in conjunction with the carefully executed illustrations, which are one of the best features of the book.

In spite of the care which has evidently been taken, both in the actual compilation and in the "proof" reading, there are a few inaccuracies and doubtful statements still existent in the text to which reference may be made. It is not quite accurate to say that "no authentic case of antagonistically-acting alkaloids occurring in the same plant is at present known" (p. 6), since aconitine and aconine, which are stated (p. 330) both to occur in the root of *Aconitum Napellus*, have been shown to possess opposed physiological activities. Podophyllin is not, as suggested (p. 8), a "neutral principle," which, when used in the ordinary sense, means a single definite substance, but is a mixture of resins. The reference to the "theoretically possible number of terpenes" (p. 11) is misleading, since the number cannot be computed with our present knowledge of these bodies. Gums are not, as stated (p. 15), carbohydrates, and this statement does not harmonise with that given later (p. 16), that arabin, the chief constituent of gum arabic, is a mixture of salts of organic acids. Potassium hydroxide "can be handled with safety" (p. 111) is, to say the least, not a wise saying to place before students. Milk sugar (lactose) is wrongly described (p. 233) as not fermentable.

On general grounds exception may be taken to such a loose and carelessly worded statement as "on the differences in solubility of alkaloids is based the *principle* of standardisation" (*i.e.* of drugs and galenical preparations of these), and to such a sentence as "hyoscine and scopolamine have a somewhat *different* constitution *to* atropine and hyoscyamine."

Such blemishes as are referred to in the preceding paragraphs do not, of course, seriously detract from the excellence of the book taken as a whole, and it may be recommended to students as a safe guide to modern materia medica, at least in so far as this has received official recognition by the British Medical Council. T. A. H.

OUR BOOK SHELF.

Die neuere Entwickelung der Kristallographie. By Dr. H. Baumhauer. Pp. viii+184; 46 plates. (Brunswick: Vieweg and Son, 1905.) Price 4 marks.

THOUGH this sketch of the more recent developments of our knowledge of crystals will be of service to the crystallographic student, it is primarily intended for those physicists and chemists who require to make use of crystallographic methods in their own researches; detailed explanations of technical expressions and crystallographic ideas are therefore given.

The work is divided into six chapters. The first treats of the definition of a crystal, the law of zones, the law of rationality of indices, and the methods of crystallographic projection; an account is given of various fluid and viscous bodies which must now, according to the researches of Lehmann, Schenck, and others, be included in the same group with solid crystals. The second chapter shows that crystals may be distributed into thirty-two classes capable of reference to six systems, each class differing from the others in the elements of its symmetry. The third chapter explains the various methods by which the class of symmetry to which a crystal belongs may be ascertained, and thus treats of the determination of facial distribution by means of one-circle, two-circle, or three-circle goniometers, and the investigation of the physical or chemical properties, more especially optical anomalies, circular polarisation, pyroelectric behaviour, and the etch-figures developed on crystal faces as a result of solvent or chemical action; the last mentioned is a branch of crystal research to which Dr. Baumhauer has himself given much attention. The fourth chapter gives a discussion of the regular growths met with in crystals, and in this connection a detailed account is given of mimetic growths such as are observed in the case of the felspars. In the fifth chapter is a description of the development of crystal faces; an account is given of Goldschmidt's "law of complication" and of nodal points. The sixth and last chapter deals with isomorphism, morphotropy, topical axes, polymorphs, and the relations between the chemical formula and the crystal system of a substance. The observations of Prof. Miers relative to the vicinal faces of alum crystals, and the researches of Dr. Tutton on the relation between the chemical composition and the morphological and physical properties of a substance are specially mentioned. Prof. Baumhauer's long experience as a teacher has enabled him to give an account which is at once well up to date and of a readable character.

La Théorie moderne des Phénomènes physiques. Radio-activité, Ions, Electrons. By Prof. Augusto Righi. Pp. iv+125. (Paris: L'Éclairage Électrique, 1906.)

THIS is a translation from the Italian. The book is a good semi-popular account of recent physical developments, and is likely to be useful to those desirous of gaining a first acquaintance with them. Even original investigators will here and there glean useful hints or ideas.

Prof. Righi, we are interested to note, prefers the use of an electroscope of almost microscopic dimensions for detecting minute radio-active effects. A systematic inquiry into the best dimensions for these instruments is very desirable, and might be advantageously made either from a mathematical or from an experimental standpoint.

In one or two cases Prof. Righi quotes investigations of which the soundness may perhaps be doubted—for instance, the alleged occurrence of radiations from phosphorescent zinc sulphide capable of penetrating opaque bodies, and the determination of the velocity of Röntgen rays made by M. Blondlot. This last experiment depended on the action of the Röntgen tube on a minute electric spark. This action was afterwards attributed by M. Blondlot to the *n*-rays, and the objective existence of the *n*-rays is now generally discredited.

We have seen an English translation of Prof. Righi's book. The French translation is not, therefore, of special interest to English readers.

R. J. S.

Modern Lightning Conductors. By Killingworth Hedges. Pp. viii+119. (London: Crosby Lockwood and Son, 1905.) Price 6*s.* 6*d.* net.

THE subject of lightning protection is one of considerable importance to architects, and a book in which the existing information thereon is conveniently collated is therefore to be welcomed. Mr. Killingworth Hedges's long association with this very special branch of electrical engineering enables him to write with authority. The book may be regarded as a very useful work of reference on the subject, as it contains a summary of the recommendations of the lightning research committee of 1905, together with numerous extracts from the observers' reports on buildings which had been struck by lightning, which served as the basis on which the committee drew up its suggestions. These extracts are copiously illustrated and the faults in the details of the protection in each case are clearly pointed out. The book is enlivened by the last chapter, which gives several instances of peculiar results of lightning strokes.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Inventor of the Nicol Prism.

CAN any of your readers supply me with the dates of birth and death of William Nicol, the inventor of the Nicol prism? There is a tablet to his memory in the Wariston Cemetery, in Edinburgh, bearing an inscription drawn up by the late Prof. Tait. Strange as it may seem, though his fame is world-wide in optics, he is not even mentioned in the "Dictionary of National Biography," nor do I know of any memoir of him elsewhere.

SILVANUS P. THOMPSON.

Technical College, Finsbury, London, E.C., February 6.

Result of War affected by Soldier's Stature.

THE Japanese had an unquestionable advantage in the recent war as being smaller than the Russians; they were smaller targets for fire-arms. I wish to point out that it is possible to express this advantage quantitatively on the assumption, justifiable in modern war, that bullets are, on the average, uniformly distributed over the target presented by a man's body, also that a man presents a target proportional in area to the square of his height. The Anthropological Institute has kindly given me figures for the purpose; the average height of 2500 Japanese, 1260 of them being soldiers, was 1585 millimetres as compared with an average of 1642 millimetres for the average of 177,948 European Russian conscripts. The average Russian height thus exceeds that of the Japanese by about 3·47 per cent. The squares of the two average heights, representing, as I have said, the average targets offered by each to an enemy, differ therefore approximately by 7 per cent., so that the Russian fire was relatively ineffective to that extent.

JOHN H. TWIGG.

The Hydro, Ben Rhydding, Yorkshire, February 1.

Scintillations produced by the Electronic "β-Rays" emitted by Radium.

As the β particles emitted by the radio-active elements are analogous to the α particles, inasmuch that they may be considered as parts of the disintegrated atom, and not in any sense true rays, I have been conducting some experiments with the view of ascertaining if, in any circumstances, their action upon fluorescent screens caused recognisable scintillations. It will be obvious that if the radium used be placed too near the screen, the effects of the combined β and γ rays will produce a fluorescence sufficiently vivid to mask any scintillations due to the individual electrons which compose the β stream. In order to diffuse this action and allow the β particles to separate to such a degree that the flashes produced shall not overlap, recourse may be had to three methods :—

(1) Increasing the distance between the radium and the screen.

(2) Making the stream pass through material offering resistance to its passage.

(3) Reducing the quantity of radium used and "diluting" the action by mixing it with non-active substances.

I have tried these methods separately, and in each case have obtained results which were fairly satisfactory considering the difficulties attending this class of observation.

In these circumstances the screen, when viewed with a lens having a focus of about half an inch, was seen to be fluorescing with a faint glow, which was, without doubt, of an unsteady and flickering character.

The phenomena involved are delicate and difficult to observe, requiring the best possible conditions. It is very important that the eyes are thoroughly rested before the observation is made, but the fact that the glow is flickering and strongly suggestive of scintillations is, in my opinion, beyond dispute. After trying various combinations of the above methods, I have obtained results sufficiently decided to justify the statement that the screen was lit up by scintillations properly so called. A screen of zinc sulphide, so very excellent for viewing the scintillations produced by the α particles, does not give satisfactory results for the β stream.

Willemite and barium-platino-cyanide are both fairly good, the latter being rather the better of the two. I have obtained the best results with an ordinary X-ray screen. Having enclosed about 15 or 20 milligrams of radium-barium-bromide (1 per cent.) in a small glass tube, I placed over it a sheet of mica. Over this was placed a sheet of cardboard, and above this again, at a distance of about half an inch, was the screen. When the lens was focused on the screen, a dim fluorescence, due to the γ rays, was seen as a sort of background, on which were visible faint nebulous scintillations coming and going in a manner very similar to the scintillations produced by the α particles on a zinc sulphide screen. C. W. R.

February 2.

The Effect of Food on the Colour of Moths.

IN a very interesting paper published in the *Journal of Economic Biology* (1905, No. 1), Mr. W. E. Collinge describes and figures a remarkable series of specimens of the magpie moth (*Abraxas grossulariata*, Linn.), obtained as the result of raising the larvæ on lettuce, the ordinary food being currant. The specimens all differed from the type in the direction of great loss of markings, the most extreme one representing the aberration known as *dohrni* or *deleta*. The same sort of effect has been produced on the tiger moth by G. Koch, as a result of feeding the larvæ on lettuce; and a good account of various experiments of the same kind is given by Dr. Vernon on pp. 288–9 of his work on "Variations in Animals and Plants" (1903).

The effect produced in the cases cited may be regarded as a sort of compulsory mutation, though we do not know whether it could in any case be inherited in such a manner that it would remain constant under different conditions. If the normal maculation, which has existed for countless generations, can be transformed in a single one by a new food-plant, it is not likely that the alternate type can be any better fixed.[1] The species must be regarded as potentially dimorphic, indeed, polymorphic, for other quite different aberrations occur. There arises, however, an interesting possibility. Mr. Collinge found that the insects were raised with difficulty on lettuce, and he doubted whether it would be possible to raise three successive generations exclusively on that plant. Suppose, however, that among many which fed on lettuce (or any unwonted food) a few were able to survive, and consequently a lettuce-feeding race became firmly established. Such a race would show the same marked differences from the type which appeared in the first generation, and it is not unlikely that at length it would be as difficult to get its members to live on currant as it originally was to get the currant-feeders to survive on lettuce. We should then have a lettuce-feeding form, very easily distinguished from the currant-feeding one, and nobody would hesitate to call it a distinct species. If it absolutely refused to feed on currant, the peculiar markings would be as fixed as in any species known.[1]

[1] In this connection, *cf.* "The Principles of Heredity," by G. Archdall Reid, 2nd edition, Appendix A, pp. 355–356.

These suggestions appear to have the more force from the fact that some of the lettuce-fed examples strongly recall *Abraxas sylvata*, which feeds on elm, and is universally considered distinct. This *A. sylvata* and its allies form a group of closely allied races in the Palæarctic and Oriental regions, and it would be extremely interesting to ascertain whether these several forms have different food-plants, and whether by changed conditions they can be derived from one another. Many years ago I had occasion to tabulate these forms, using the material in the collection of the British Museum, and in the hope that the matter may be taken up by some eastern entomologist I give here the brief table I made :—

A.—*Markings strongly developed.*
- (*a*) Expanse about 34 mm.; Europe, Siberia, &c. . . . *sylvata*, Scopoli.
  - (α) Markings stronger than type or darker; brown anal blotch more reduced; Japan, &c. . . *sylvata* var. *intensa*, Warren.
- (*b*) Larger; nearly always more than 40 mm. expanse.
  - (α) Markings strong and dark. China and Japan . . . *miranda*, Butler.
  - (β) Markings paler. India . . . *leopardina*, Kollar.
- (*c*) Still larger; expanse more than 50 mm.; markings rather pale.
  - (α) Markings more suffused. N. China . . . *plumbeata*, Warren.
  - (β) Markings less suffused. Silhet . . . *illuminata*, Warren.

B.—*Markings much reduced, but the brown blotches remaining well developed.*
- (*a*) Expanse more than 40 mm.; markings rather more developed than in *pantaria*. India . . . *paucinotata*, Warren.
- (*b*) Expanse more than 35 mm.; Europe . . . *pantaria*, Gn.
- (*c*) Expanse about 30 mm.; markings still more reduced. Europe . . . seasonal form *calaria*, Gn.

Since the physiological adaptation to the new food-plant is not really connected with the change of colour or maculation, it may frequently take place without any externally visible signs, or such signs may only arise after a long period. In this way we get "physiological species," which are no doubt more numerous than is generally supposed. T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, U.S.A., January 18.

A Correction.

IN the review of Prof. Fr. Czapek's "Biochemie der Pflanzen" (NATURE, vol. lxxiii. p. 192) I mentioned that I missed a certain paper by Schjerning. The author's name should have been Weis.

I also overlooked the reference to a paper by Cornevin. An index of authors' names would enhance the utility of the book. F. ESCOMBE.

[1] Pictet, quoted by G. A. Reid, reported that after several generations on a new food-plant, certain butterflies which had at first been modified reverted to the original type. Of course, the case I have imagined is one in which this does not take place, but experiment is needed to test the possibilities indicated.

A METRICAL AND PICTORIAL RECORD OF THE EARTH'S HISTORY.[1]

THE author of this curious book tells us that it is an attempt to present a sketch of the evolution of the earth on the nebular hypothesis, to note also subsequent sea and land movements, and successive appearances of life as revealed by the geological strata. The geological record of past life remains very imperfect; still, many additions, notably from strata in Egypt and North America, have been made in recent years, and studied in the light of the doctrine of evolution its revelations have become more intelligible.

Why the author should imagine that to describe in rhyme the history of our planet and its inhabitants, from the earliest times to the present day, would render the subject simpler and more attractive to the general reader it is hard to imagine; but still, precedents are not wanting in such works as Dr. Darwin's "Temple of Nature," Pope's "Iliad," Henry's "Latin Grammar," and a poetic history of England, to justify the author's contention that it is an appropriate form in which to present a cosmical and palæozoological work to the public.

We fully agree with him that the theme is deserving of a much higher form of treatment, and that some day a great poetic genius may take it in hand. We cannot help feeling, however, that prose would have best befitted the aim of the present work. The author has had both an academic and geological training, and knows, from the study of text-books, museums, and extensive travel, a great deal about the subject on which he rhymes, and he has had the advice and assistance of a great number of learned scientific men whose names are duly recorded in prose in the preface. But the feature which renders this work of special interest is its fine series of illustrations, fourteen being executed in colour-processes by E. Bucknall, L. Speed, C. Whymper, and others, and seventy-seven by tint process reproduction. These give animation and attractiveness to the work, and will doubtless induce many purchasers by the beauty or the weirdness of the subjects pourtrayed.

Commencing with the astronomical aspect of the earth, there is a very fine plate of "the great Nebula of Orion" (from the Yerkes Observatory, Wisconsin, U.S.A.), and of "a Spiral Nebula in *Canes venatici*," from the Lick Observatory, California.

There is a charming Cambrian marine scene with crinoids, star-fish, trilobites, and medusæ, drawn by Alice B. Woodward, and an equally attractive Silurian (submarine) view by the same artist. No fewer than thirty plates have been executed by J. Smit, who illustrated two little books by the Rev. H. N. Hutchinson called "Extinct Monsters" and "Creatures of Other Days." But having become accustomed to the life-like restorations of Mr. Chas. R. Knight, made under the direction of Prof. H. F. Osborn, of the American Museum of Natural History, New York, we feel that Mr. Smit's extinct animals are tamer and somewhat lacking in that high artistic merit which Mr. Knight's drawings possess. The coloured plates by E. Bucknall, L. Speed, and Charles Whymper are of a different order. E. Bucknall's cave-men carving on bones by firelight (p. 200), the "Neolithic Farmstead" (p. 214), the landscape in the Carboniferous period (p. 35), or his excellent conception of Sivatherium, a huge horned Pliocene giraffe, with a dappled hide like its long-necked modern descendant are most admirable. Lancelot Speed's primitive man and woman, although a clean shaven and washed, and intellectual looking couple, make a very good frontispiece. His Devonian, Triassic, and Eocene landscapes are also excellent and original. There is much merit and ability displayed in Chas. Whymper's Jurassic landscape with pterodactyls and a gavial hunting the duck-billed Ornithorhynchus, but we do not remember this monotreme occurring in any Jurassic rocks. The other novelties afforded by the book illustrations are from the facile pencil of Alice Woodward, as the Jurassic period (p. 62), with its ammonites and crustaceans; the restoration of *Diplodocus carnegiei* (p. 72); the Cretaceous sea-beasts (p. 83); Polacanthus, a reptile from the Isle of Wight reconstructed by Dr. Francis Baron Nopcsa (p. 88); restorations of various ancestral forms of elephants lately unearthed in Egypt; Mœritherium (p. 114); Palæomastodon (p. 114); and Tetrabelodon (p. 125); most remarkable of all those lately come from the land of the Sphinx is the Arsinoitherium (p. 120), a weird-looking herbivor, with quadricorn defences on its frontal bones and a full dentition of 44 teeth in its jaws not, however, in the ancestral line of elephants, nor perhaps of any living group, but *sui generis*. This, and the ancestral forms of elephants, are about to be published by the Trustees of the British Museum, as a monograph on the fossil mammalia, &c., from the Fayûm, Egypt, prepared by Dr. C. W. Andrews.

FIG. 1.—Polacanthus restored from skeleton found in the Isle of Wight, and now in the British Museum (Natural History). Total length probably about 25 feet. Reduced from "Nebula to Man."

The only other extremely novel restoration is that of the huge marsupial, Diprotodon (p. 172), the remains of which have been found in such profusion in the interior of South Australia by Dr. Stirling. The pic-

[1] "Nebula to Man." By Henry R. Knipe. With Illustrations by Ernest Bucknall, John Charlton, Joseph Smit, Lancelot Speed Charles Whymper, Edward A. Wilson and Alice B. Woodward. Pp xvi+252; with 16 coloured page illustrations and 57 tinted page illustrations. (London: M. Dent and Co) Price 21s. net.

ture of Pliocene horses by J. Charlton should also be noticed as a very spirited and excellent composition (p. 167).

FIG. 2.—Arsinoitherium (probably from 8 to 9 feet in length). From remains found in the Upper Eocene of Egypt. Preserved in the British Museum (Natural History) and in the Survey Museum, Cairo. Reduced from "Nebula to Man."

The following is Mr. Knipe's dedication of his work:—

To NATURE.

How fair, O Nature, are thy looks
  In these thy matron days:
And with what light a heart thou seem'st
To tread thy thorny ways.
  Man sees thee joying in thy life,
So full, so fresh, so free,
  As if thy toil in ages past
Had nothing been to thee.
  And well may he beneath thy spell,
Forget thy inner life,
  The waste and suffering in thy breast,
And never ceasing strife.
  Or if so be he needs must think
Of all the tumult there,
  He knows at least one end it has,—
  To make thee grow more fair.

It is not so much a matter of serious importance whether one reads patiently the carefully executed text in verse or turns with a disdainful smile from such lines as:—

"The whale-like Zeuglodonts that off these coasts,
In Eocene times pursued the finny hosts,
Are seen no more: but forms in tooth allied,
Though skulled more as the Dolphin, swim the tide."
* * * * * *

Suffice it to say that the book, as a whole, is admirably illustrated and must have cost the author a very large sum to produce. The pictures alone form an excellent guinea's worth, and will prove a real joy to the younger generation as well as to some of the elder, and there is no single picture in the book which has not been drawn expressly for the present work.

SOME MAMMALIAN TYPES.[1]

MR. RENSHAW, whose pleasant essays on African mammals are fresh in our memories, has in his new volume taken a wider field, and selected his types from the fauna of the whole world. They are still confined to mammalian forms, and this being the case it would perhaps have been possible to give these volumes a more original title than that adopted by Waterton for his famous essays published in the first half of the last century. But Mr. Renshaw's essays are decidedly original in the treatment of the subject. They deal not merely with the natural history of animals, but also with the history of our knowledge of them. Thus the history of the Addax antelope, inhabiting the great desert, is traced from the time of the ancient Egyptians and of Pliny to its modern re-discovery early in the last century; and that of the extinct northern sea-cow in connection with the adventures of the searchers after the North-west Passage.

Never before, indeed, has the history of mammalian forms been more attractively presented to the public. The history of the discovery of some of these grand forms of life is often a true romance of natural history, which, appealing strongly to the author, is graphically re-told by him; and his enthusiasm enables him to carry the reader with him to see in his mind's eye the country inhabited by the beasts he describes, and to feel some of the keen delight experienced by the hunter-naturalist when some such beautiful trophy as the sable antelope rewarded him for all his toil. He excels in describing the natural scenery—the setting—of the subjects of his essays; and writing of the Malay tapir, of "antediluvian appearance," conjures up a most realistic mental picture of the home of the Palæotheres, their ancient representatives, when in far-off days they roamed over swamps covering the present site of Paris.

The misconceptions which hang about the vampire bat in the popular mind are here cleared away, and the statement that it is difficult to stop the bleeding set up by it suggests a search of the salivary glands for any ferment that might hinder the coagulation of blood, and some interesting remarks thereon. Although it was discovered by Columbus, few people perhaps realise that a seal inhabits the warm waters

FIG. 1.—The Clouded Tiger. From "More Natural History Essays."

[1] "More Natural History Essays." By Graham Renshaw, M.B., F.Z.S. Pp. 243; illustrated. (London and Manchester: Sherratt and Hughes 1905.) Price 6s. net.

of the Caribbean Sea. The account of the Jamaican seal is all the more interesting because it seems likely to become extinct, possibly partly because it is one of those animals which, to preconceived ideas at all events, seem out of place. But in this connection we are reminded that there is also a Mediterranean seal, and that the leopard is actually as European as the brown bear. Another extinct animal which we are glad to have an account of is the Antarctic wolf of the Falkland Islands, finally exterminated by the sheep-farmers in self-defence; its possible introduction to the Falklands is discussed, and the question whether it was really distinct or merely a modified form.

These extracts will serve as a fair sample of the score of essays in the new volume. In the case of rare or extinct forms there is an indication of the known specimens now or formerly in collections. The value of photographs from life of rare, and especially of "threatened," species is emphasised by the author, who illustrates his essays with eighteen photographic plates. Even in the London "Zoo" it is not always easy to photograph an animal. The clouded tiger was under observation for five years before a satisfactory picture (which we are enabled to reproduce) could be obtained. O. V. A.

MINERS' WORM.[1]

THE dreadful disease known as ankylostomiasis, "tunnel disease," "cachexia of miners," or "miners' worm," is definitely known to be caused by the nematode worm *Ankylostoma duodenale*. The alarming spread of the disease in the mines of Hungary, France, Germany, and Belgium, and its recent introduction into some of the mines of this country, have necessitated a thorough investigation of the anatomy, development, and life-history of the worm. Already some 750 papers treating of the disease have been published, but only a few of these deal with the parasite itself, and still fewer with the details of its anatomical structure.

The splendid work before us now gives in full detail the gross and minute structure of the adult worm, but a second part is yet to come from the pen of the same distinguished parasitologist in which the development and life-history will be described. If the second part is as full of detail and as well illustrated as the first, the monograph will be the most complete account of any single species of animal that the world possesses.

The Ankylostoma was first discovered by Dubini in 1838 in the intestine of a peasant woman who died in the hospital at Milan, but it was not until some years later that he associated the worm with disease and published an account of it. Soon after Dubini's discovery the worm was found in Egypt by Pruner and by Bilharz. Dr. Looss considers carefully the suggestion that has been made that the worm Heltu mentioned in the Ebers papyrus of *ca* 1550 B.C. was Ankylostoma, and that the disease was known to the ancient Egyptians, but he comes to the conclusion that there is not sufficient evidence to support this suggestion.

The discovery of Ankylostoma in Brazil by Wucherer, and in other warm and tropical places, led to the belief that ankylostomiasis was peculiar to such climates, but the epidemic of "tunnel disease" among the workers in the St. Gothard Tunnel, and the recognition by Perroncito of its identity with ankylostomiasis, was the first indication of the serious part this worm was to play in the medical history of the present day.

Dr. Looss devotes some pages to a full discussion of the systematic position of the species and of the generic characters of this and the other genera of the family Agchylostominæ. I must confess to some disappointment that, influenced by the writings of Stiles, of Washington, the author has come to the conclusion that the genus must be written Agchylostoma. "I freely confess," he writes, "that I find the term *Agchylostoma* abominable," and throughout the monograph he uses the spelling Ankylostoma in roman letters and Agchylostoma in italics. It is extremely inconvenient, in any case, to restore an ancient and "abominable" spelling of a generic name, and it is to be especially deplored in a monograph of such value and importance as this one; but no rules of nomenclature can justify the course adopted of spelling a generic name in two distinct ways on almost every page.

The text consists of 140 pages of elaborate details of microscopic anatomy and histology, and the illustrations consist of ten plates of very beautiful drawings by the author, lithographed by Werner and Winter, of Frankfort.

The monograph was originally written in German, but has been translated with very great skill into English by Mrs. H. M. Bernard.

SYDNEY J. HICKSON.

[1] "The Anatomy of *Agchylostoma duodenale*, Dub." By A. Looss. Records of the Egyptian Government School of Medicine. Vol. iii. (Cairo: National Printing Department 1905.)

THE ROYAL COLLEGE OF SCIENCE.

MR. HALDANE and the other members of the departmental committee who for the last two years have been considering the important questions referred to them have earned the nation's gratitude. If the scheme they propose be carried out (and there is reason to believe that it will be, and at once) a great step forward will have been made towards providing that complete higher education the absence of which has made us the laughing stock of those countries the Ministers of which are more intelligent than our own. As the reporters are careful to show in their general review, many of our scientific industries are an easy prey in international competition as it is carried on to-day.

We give below extracts from the recommendations made in the final report, just issued, which will sufficiently indicate the proposals of the committee; many paragraphs have been omitted which deal with details.

The unification of the teaching which already exists or is already provided for at South Kensington, and the additional buildings, teaching and research suggested, will certainly provide an institution admirably designed to meet modern needs. But we are grateful to the reporters for more than this; they tell us with no uncertain sound that technical education must crown, and not replace, a general education, so the resources of the Royal College in the future will not be frittered away in trying to teach those who have not learned how to think and in turning out incomplete men. A sufficiency of professors is also postulated, so we may hope that researches as well as teaching will be intensified, both for professors and students.

Messrs. Wernher, Beit and Co. are happy endowers; it is not often that such munificence as theirs, which set the inquiry going, leads to such a rapid and satisfactory result. Their 100,000*l*. is now supplemented, roughly, by the interest of a million from the State, of another from the County Council, perhaps

almost another from the City Guilds, while the State and the Royal Commissioners for the Exhibition of 1851 provide between them some four or five acres of land to build on gratis!

Some paragraphs of the recommendations refer to a question which is academic in more senses than one—whether the new Royal College of Science shall be under the government of the University. Our own view is that the question should be left to settle itself. There certainly at present must be a special governing body to start it, and the one suggested seems all that can be desired. There certainly also at some future time must be a very close connection with the University; it is too early to define that time.

Extracts from Conclusions and Recommendations.

The conclusions at which we have arrived are:—

(1) That the position of this country makes further provision for advanced technological education essential.

(2) That the students, by whose advanced technological education the nation would profit, are not actually obtaining it to the extent which is desirable, and that this is due to:—

(*a*) The lack of facilities for instruction in certain important subjects.

(*b*) The absence of such coordination among existing institutions of technological education as would permit the concentration of the more advanced courses in a limited number of institutions.

(*c*) An insufficient appreciation, especially on the part of employers, of the value of such education.

(3) That the opportunities for research in our technological institutions are inadequate to the industrial needs of the Empire, owing not to any want of ability on the part of the professors, but to the fact that much of their time is frequently absorbed in the giving of comparatively elementary instruction in pure and applied science.

(4) That in any institution in which the highest technological education is given, the equipment should be adequate for the purpose, and the staff should include, at the head of the several specialised branches of the work, men of the first rank in their profession.

From this point of view the recommendations which we have the honour to submit in reply to our terms of reference may be summed up as follows:—

That the present combination of conditions at South Kensington points to the desirability of so utilising the resources there available, and of making additions to these, as to form on that site an institution of the highest standing, an institution which, with the staff, equipment, and students that it will command, would go far towards remedying the above mentioned defects.

In a preliminary report we inquired whether the Board of Education were in a position to inform us (1) that, if it were found possible to establish a scheme such as we had sketched in outline, they would be willing to allow the Royal College of Science (including the Royal School of Mines) to be brought into it under a common government and administration; and (2) that the existing Government contribution to the support of these institutions would be continued under the new conditions on the scale already made necessary by the provision of the new laboratories of the Royal College of Science.

The Board have replied to the first of these questions in the affirmative, and, in reply to the second, the Government have intimated that they will be prepared to bring the Royal College of Science and Royal School of Mines, including the new laboratories, into a scheme framed on lines approved by the Board of Education, in accordance with this report, and to make a grant of 20,000*l.* per annum in respect of the cost of staff and of the laboratory expenses, with provision in addition for certain other minor expenses.

The favourable disposition of the Government has greatly strengthened our position, and enabled us to obtain the support and cooperation which we consider necessary to ensure the success of the scheme described generally in our preliminary report.

The gift of a capital sum in excess of the minimum referred to (100,000*l.*) in the preliminary report has been secured.

The commissioners of the 1851 Exhibition are prepared, if satisfied with the scope and constitution of the new institution, to place at the disposal of its governing body the unoccupied portion of their estate at South Kensington.

The council of the City and Guilds of London Institute have indicated their willingness to bring the Central Technical College into a scheme to be framed to their satisfaction on the general lines we are able to recommend in this report.

The London County Council, on July 27, 1903, received a report from its General Purposes Committee upon the proposal contained in the letter which Lord Rosebery had a short time previously addressed to the chairman of the Council, and resolved to place on record its opinion that, subject to certain conditions being fulfilled (about which we may say we do not anticipate any difficulty), the Council would be well advised, when the time came, to contribute a sum not exceeding 20,000*l.* per annum towards the maintenance of the institution.

In our opinion a sufficient maintenance fund is assured, at any rate, to justify a commencement, if not to carry out the scheme we have in view as fully as we hope may be possible hereafter.

The main object is the establishment, at South Kensington, of an institution or group of associated colleges, of science and technology, where the highest specialised instruction should be given, and where the fullest equipment for the most advanced training and research should be provided, in various branches of science, especially in its application to industry, for which no sufficient provision already exists elsewhere. The number of the departments will be limited by the resources available, and at first a selection will have to be made among them. The scale on which the departments are established should be capable of gradual expansion with the increase in the number of students, fitted by preliminary education, to take advantage of the teaching and training contemplated.

The scheme should, in the first instance, and subject to necessary adjustments, include the work of the Royal College of Science, the Royal School of Mines, the Central Technical College, and departments to be established on the additional site at South Kensington.

Such being the scope of the new institution, it is necessary that we should make recommendations with regard to the composition and functions of its governing body. Of the relation of the new institution to the University of London, it is necessary to premise that we are agreed that it is desirable that the new institution should be established immediately, and that its organisation should proceed without delay, and there is substantial agreement among us that for this purpose a governing body of the character sketched in a subsequent paragraph should be at once appointed with power to take immediate action. We wish, however, to put in the forefront of our recommendations under this head a proviso that they should not be regarded as in any way intended to prejudice the future settlement of the question of the relation between the new institution and the University. This is a question on which divergent views are held.

We do not consider that the establishment of the new institution should be delayed pending a decision between these two views, or that the general lines of its organisation (except, possibly, as respects the governing body) should be regarded as other than permanent.

Subject to the proviso we have already made, we recommend that a governing body should be established consisting of forty members appointed as follows:—

Six by the Crown.

Four by the Board of Education.

Five each by the University of London, the London County Council, and the council of the City and Guilds of London Institute.

Four by the teaching staff of the new institution.

Two by the commissioners of the Exhibition of 1851.

One each by the Royal Society, the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Iron and Steel Institute, the Institution of Naval Architects, the Society of Chemical Industry, the Federated Institution of Mining Engineers, and the Institution of Mining and Metallurgy.

For the purposes of the new institution the governing body should have the entire disposal of the accommodation provided by the Royal College of Science, including the buildings in course of construction at South Kensington, the Central Technical College, and all buildings which may be erected on the additional site at South Kensington.

The site and buildings of the Royal College of Science, including the buildings in course of construction, should either remain the property of His Majesty's Government or be transferred to the governing body of the new institution, as His Majesty's Government may determine.

The site and buildings of the Central Technical College should, if and so long as they desire it, remain the property of the City and Guilds of London Institute, who should provide for their maintenance and repair.

The governing body should be incorporated, and subject to such special provisions as may be made by their instrument of incorporation they should receive and expend fees and other funds which may be assigned to the purposes of the new institution, they should appoint the professors and the other members of the staff, they should determine the departments and subjects of instruction, they should control the arrangement of the courses of instruction, and the award of diplomas, and they should make provision for the protection of students now in the constituent institutions and of the existing diplomas. Further, in each of the departments of the new institution the governing body should appoint a board, not necessarily consisting of members of their own body, and including members of the teaching staff and persons with practical experience of industrial requirements, to give expert advice with regard to such particulars connected with that department as the governing body may refer to them.

We recommend that it be an instruction to the governing body to enter into negotiations with the University of London, with King's College, and pending its actual incorporation, with University College, with regard to the coordination of the engineering work of these colleges with that of the new institution. We recommend that instruction in the higher branches of technology should, as far as possible, be concentrated at South Kensington. In the establishment of new departments we do not think it will be possible at present to go much beyond the various branches of engineering, with mining and metallurgy, though we hope provision may be made later for other subjects. We think the principal technical and engineering societies should be consulted as to the departments most requiring development and expansion, and as to the number of students for whom it is desirable to make provision in each department. In view of the character of the subjects which will, it may be expected, predominate on the South Kensington site, it must, we think, before long become a question whether the biological department of the Royal College of Science shall be retained there. As soon as this question becomes ripe for settlement, the provision to be made for that department will be a matter for negotiation.

We think that it may be found possible, even in the immediate future, to make arrangements for the establishment of departments dealing adequately with the greater number of special sections of applied science named. Thus it would seem that certain of these departments might be accommodated in the buildings of existing London institutions, while, for others, special accommodation would fall to be provided at once in the first additions to the buildings already available on the South Kensington site. For example, in view of the character and standard of the work now carried out by the Central Technical College, we think prominence should be given in the new institution to certain specialised developments of mechanical and electrical engineering.

We have already reported that we think a fully equipped central school of mines should be maintained, providing a full course of instruction in mining and metallurgy, especially in the mining and metallurgy of metals produced in India and the Colonies, but not found in workable quantities in the United Kingdom.

It should be borne in mind that the traditions and prestige of the Royal School of Mines and the associateship of that school are valuable assets, and we think care should be taken to preserve those traditions and that diploma.

In our opinion, accommodation should be provided in this department for 100 to 120 fully qualified students, *i.e.* fifty or sixty entries in each of the two years contemplated, so that forty to fifty students might be expected to pass out each year after successfully completing the course.

Vacation work under the guidance of school authorities, in districts where practical work is conducted, is a great and valuable feature of American and Canadian schools of mines. We think it would be advantageous for students of the Royal School of Mines to have one short period of practical mine surveying and of mining work generally, in a metalliferous mine, and another similar period of experience of the work of a coal mine.

No student should be admitted to any specialised technical department who has not received, either in the new institution itself or elsewhere, an adequate training of a technical and scientific character such as should be common to every branch of engineering. He should have spent two years on a course of instruction in science, such as he could obtain in a well organised college or technical institution, after having reached the standard of general education usually marked by university matriculation. An examination test should be imposed on all candidates for admission to the higher departments, except in the case of students who show, by some recognised qualification, that they have received the necessary preliminary training, and when there are more candidates for admission to a particular department than can be received, the best should be selected on a competitive basis.

The preliminary training to be given in the new institution should be of the kind which has just been referred to. It should consist of a course of two years' instruction in science, technology, and engineering, of such a character as the governing body consider the most suitable preparation for the specialised courses, and it should be, in the main, common to all students proceeding to advanced instruction in any department. We have already indicated our opinion that students who have not attained a certain standard of general education are not fitted to obtain the fullest advantage from the specialised instruction of the higher departments. We therefore think that evidence of this should be required before admission to the preliminary department.

NOTES.

SIR ALEXANDER B. W. KENNEDY, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

PROF. ALBRECHT PENCK, of Vienna, has accepted the professorship of geography in the University of Berlin, vacant by the death of Prof. von Richthofen.

THE Nichols medal of the American Chemical Society for the year 1905 has been awarded to Prof. Marston Taylor Bogert, of Columbia University, for his researches on the quinazolines.

Science announces that Dr. C. D. Walcott has resigned the secretaryship of the board of the Carnegie Institution at Washington, and is succeeded by Mr. Cleveland H. Dodge.

A MEMORIAL tablet has been unveiled on the house, in Eisenach, in which the late director of Zeiss's works, Prof. Abbe, was born.

ARRANGEMENTS have been made to hold a hygiene exhibition in Dresden in the year 1909 under the directorship of Dr. Lingner.

FROM Tübingen the death is announced, on January 25, of Prof. W. Mayer, the director of the university pharmacological museum, and a member of the pharmaceutical examinations commission.

WE learn from *Science* that, in accordance with the recommendations of Prof. John B. Smith, a Bill has been introduced into the New Jersey Legislature appropriating 14,000*l.* a year for five years for the extermination of mosquitoes.

A REUTER message from Naples states that Vesuvius is still active. The lava has reached three places on the Vesuvian railway line, covering about 100 yards of the line at each point. The lava threatens the line at a fourth point, as well as the station of the funicular railway, which is no longer working.

THE Friday evening discourse at the Royal Institution on February 16 will be delivered by Mr. W. C. D. Whetham on "The Passage of Electricity through Liquids," and on February 23 by Prof. J. O. Arnold on the "Internal Architecture of Metals."

A GREAT mass of rock having a weight estimated at 70,000 tons at the lowest, and placed by some at half a million tons, fell at Cheddar Cliffs on Sunday night. The fall took place on the face of the cliff, and the disaster is attributed to quarrying operations.

THE *Electrician* states that the forty-fourth Congrès de Sociétés savantes will be opened at the Sorbonne on Tuesday, April 17. The congress will continue until Friday, April 20, and on the following day it will be concluded by a meeting in the great amphitheatre of the Sorbonne, presided over by the Minister of Public Instruction and the Fine Arts.

DR. LEWIS GOUGH has been appointed to assist Dr. Gunning in the management of the museum at Pretoria. The department for which he will be responsible will be that containing the fishes, the amphibia, and reptiles—groups of animals which were especially under his charge when he was an assistant in the museum at Strasburg. Recently Dr. Gough has been working at Plymouth on the plankton of the British Channel in connection with the British Marine Biological Association.

A SECTION of the Swedish Government is again anxious to impose an export duty on outgoing Swedish iron ores. A suggested duty of 20 öre per ton is desired, whilst the revenue accruing therefrom is to be applied to furthering the cause of the Swedish iron industry.

ON January 30 Mr. W. H. Cope, librarian to the University of Birmingham, was presented with an oak clock and a cheque by Prof. J. H. Poynting, F.R.S., on behalf of a number of present and past members of Mason College and of the University, on the twenty-fifth anniversary of Mr. Cope's appointment as librarian.

THE friends and pupils of the late Prof. A. Hilger, professor of pharmacy in the University of Munich, have decided to perpetuate his memory in the university town of Erlangen, the seat of his activity for many years. It is proposed to erect a handsome monument to the deceased man of science in the palace garden in front of Hilger's former laboratory. Communications and contributions are to be addressed to Dr. Späth, chief inspector of the Royal Analytical Institute, Erlangen.

THE twenty-fifth anniversary of the foundation of the Berlin Agricultural High School was celebrated on January 25; among those present were a number of relatives of the late Albrecht von Thaers, who is regarded as the reformer of agricultural teaching and of the science of practical agriculture in Germany. The rector of the school, Prof. Orth, chose as the title of his address "Agriculture up to the Time of Thaers."

WE learn from the *Times* that Sir Robert L. Patterson, who died at his residence near Belfast on January 29, was the second son of the late Mr. Robert Patterson, F.R.S. He was a member of the British Ornithologists' Union, and recognised as a high authority on Irish birds. For very many years he was associated with the Belfast Natural History and Philosophical Society, of which he was twice president for terms of two years each, in 1881 and 1894. He also took an active interest in the Ulster Fisheries Biology Association, of which he was a life member and a vice-president. He was a Fellow of the Linnean Society of London.

WE regret to record the death, in his forty-seventh year, of Mr. C. J. Cornish on January 30. Educated at Charterhouse and Hertford College, Oxford (of which he was a Fellow), Mr. Cornish at the conclusion of his college career was appointed an assistant master at St. Paul's School, a position he held until his death. He was the author of a number of articles in the *Spectator*, as well as of several books, bearing more or less closely on the popular side of natural history, and his innate love of nature, coupled with an agreeable style, made all his works a success. Among his best known books may be mentioned "Life at the Zoo" (1895), "Nights with an Old Gunner" (1897), and "The Naturalist on the Thames." In addition to these, he was editor of the "Living Animals of the World," published in parts by Messrs. Hutchinson, and was commissioned to write the "Life of Sir William Flower" by the relatives of that distinguished zoologist.

IN Natal, where a local committee has been formed to cooperate with the Imperial Cancer Research Fund (says the *British Medical Journal*), the question of the occurrence of malignant disease among such coloured races as inhabit the colony, and also among the lower animals, birds, fish, and reptiles, is being actively investigated. So far as is possible, the assistance of all practitioners of human and veterinary medicine has been secured, and endeavour has likewise been made to enlist the sympathies of naturalists and sportsmen. All specimens of suspected cancerous disease are being examined at the Government Laboratory, Pietermaritzburg, free of charge. The honorary secretary of the committee is Dr. W. Watkins-Pitchford.

SIR JAMES CRICHTON-BROWNE presided over the twenty-third annual dinner of the Sanitary Inspectors' Association on February 3. Sir W. Broadbent gave the toast of "Science and Art," and testified to the zeal with which sanitary inspectors discharged their duties in the battle against disease. The president, in proposing the toast of the "Sanitary Inspectors' Association," referred to the recent suggestions of Sir F. Treves that disease is beneficent, and passed on to consider the important work carried out by sanitary inspectors. The ravages of tuberculosis were particularly referred to as an example of the striking effects of sanitary reform. Sixty-seven years ago pulmonary consumption was annually killing 68,000 persons in England and Wales, or 3800 per million living. Since then there has been a gradual diminution in this death-rate, until now the number of deaths is 40,000 per annum, or a death-rate of 1200 per million. It has been estimated that by 1930 the disease may be almost unknown. It is necessary to have compulsory notification, universal disinfection of houses in which cases of consumption have occurred, and isolation and sanatorium treatment on a large scale.

THE inaugural meeting of the Mining and Geological Institute of India was held at Assansol on January 16. A brief account of the origin and objects of the institute was given by Mr. W. H. Pickering, chief inspector of mines, to whom, with Mr. T. H. Holland, F.R.S., director of the Geological Survey, the institute owes its inception. The object of the new society is the promotion of the study of all branches of mining methods and of mineral occurrences in India, with a view to disseminate information obtained for facilitating the economic development of the mineral industries of the country. Mr. Holland was elected president, and in his presidential address, we learn from the *Pioneer Mail*, he pointed out the true relations between the science of geology and the art of mining. He dwelt upon the advancement made in recent years in scientific mining, particularly emphasising the need of cooperation in publishing the results of practical and scientific investigations. On the following day the meeting was closed by a banquet, when Sir Andrew Fraser expressed the hope that the institute would succeed in bringing the officers of the geological department, inspectors of mines, and also *ex officio* honorary members, into touch with the practical men belonging to the mining community.

DURING his Administratorship of Dominica and of the Leeward Islands, Mr. Hesketh Bell has been very actively engaged in an inquiry which has served to show that the West India islands are not so frequently visited by disastrous hurricanes as has been generally believed, and that the Press reports of the occurrences are almost invariably greatly exaggerated. Tropical hurricanes are annual phenomena in the south-western portion of the Atlantic, but it is only when the centre of one passes over or close to an island that much damage is done on land. Mr. Bell has found that between 1800 and 1875 the British islands in the Leeward group were visited by only seven hurricanes. As the popular error on this subject, and the highly coloured accounts of the disasters, militated seriously against agricultural enterprise in the islands—having proved powerful factors against the investment of capital, and rendering it difficult for landowners to raise loans, save on very onerous terms—Mr. Bell has submitted the whole of the facts to a leading London firm of insurance brokers, and the result has been the completion of a scheme of hurricane and volcanic eruption insurance for the West Indies, the rates quoted being 30*s*. per cent. on buildings, cultivations, and crops of all kinds, except bananas (the ratio of risk in this case not being yet ascertained), and 10*s*. extra per cent. for risks against volcanoes. The huts and small tenements of the very poor are not included in the scheme. These fragile structures, naturally, are the first to go down before the storm, but they are easily re-erected. Properly worked and supported, the scheme should result in a decided reduction in the loss from hurricanes, and the islands generally should benefit from the greater confidence and sense of security of investors.

MR. L. M. LAMBE has sent us a copy of a paper on new species of tortoises, referable to the living genus Testudo and the extinct Bäena, from the Oligocene of the Cypress Hills, Assiniboia. The original paper is published in the *Ottawa Naturalist* for January.

THE two articles forming the contents of the third part of vol. lxxx. of the *Zeitschrift fur wissenschaftliche Zoologie* are of a nature which appeals to the specialist, and are too technical even to be summarised in our columns. In the one Mr. D. Tretjakoff treats of the front half of the eye of the frog and its development, while in the second Messrs. Otto and Tönniges discuss the development of the pond-snail commonly known as *Paludina vivipara*.

WE have received an advance copy of the report of the Yorkshire Naturalists' Union for 1905, in which the appointment of Mr. W. E. Clarke, of the Edinburgh Museum, as president for the current year is announced. The union is in a flourishing condition, and carrying on its work with the usual vigour. Ornithologists will be pleased to learn that arrangements have been made for the publication, in two volumes, of a work on the birds of Yorkshire, at the price of one guinea to subscribers.

IN a pamphlet issued by the Government Press at Calcutta, Mr. E. P. Stebbing describes certain bark-boring beetles which are inflicting much damage on the pine-forests of the Zhob district of Baluchistan. Chief among these is a species of the genus Polygraphus, which is described as new under the name of *P. trenchi*. Large numbers of dead and dying pines are to be seen in the forests, and it is considered probable that they are on the increase.

THE mode in which lungless (and gill-less) salamanders breathe forms the subject of investigations undertaken by Miss Seelye on *Desmognathus fuscus*, the results of these being published in a recent issue (vol. xxxii., No. 9) of the *Proceedings of the Boston Society of Natural History*. From this it appears that respiration is effected by means of the combined action of the mucous membrane of the pharynx and œsophagus, regulated by breathing movements of the nose and mouth, and of the skin.

A COPY of the "Naturalists' Directory" for 1906–7 has been received. While its usefulness cannot be denied, this little work stands in sore need of editing. To mention only a few instances, we find the names of the late Lieut.-General MacMahon, Dr. W. T. Blanford, and Mr. H. B. Medlicott figuring in the list of geologists (Dr. Blanford also in the zoological list), while the Duke of Bedford is referred to merely as an "F.L.S.," instead of as president of the Zoological Society. Expert assistance should be engaged before another edition is issued.

THE habits and distribution of the "false scorpions," Pseudoscorpionidæ, and more especially those of the species *Chelanops oblongus*, are discussed by Dr. Berger in vol. vi. of the *Ohio Naturalist*, the paper being reprinted as a Bulletin of the Ohio University. A figure and description of the curious "moulting-nests" of Chelanops are given. These, it seems, are not constructed by the female parent for her entire brood, but are made singly by each immature individual when the time for changing its coat arrives.

DEVELOPMENT and embryology from the evolutionary standpoint form the key-note of the contents of the first number of *Biologisches Centralblatt* for the current year, Mr. F. Dahl contributing a paper on the physiological importance of breeding-selection in its widest sense, as exemplified by spiders of the family Lycosidæ, while Mr. R. Kossmann emphasises the importance of favourable variations in influencing breeds and species, and Mr. Henriksen, in the first part of a dissertation on development from the functional point of view, urges that everything in nature tends towards a state of equilibrium peculiar to itself. In the last named article the author states he will "endeavour to show that the theory of the structure of germ-plasm [proposed] by Weismann is un-

necessary, and when worked out in details is quite absurd, and that we have no right to claim that the egg is some kind of a microcosm of the ontogeny and a short recapitulation of the phylogeny of the organism into which it develops.'

IN the course of a paper on phosphorescent marine animals, published in the January number of the *Zoologist*, Prof. McIntosh states that there are four distinct modes in which the light is produced. First, there may be special cells which secrete, in certain circumstances, phosphorescent mucus. Secondly, special cells may be phosphorescent without the emanation of any visible secretion. Thirdly, light may be emitted without any differentiation of tissue under nervous action. Fourthly, the phosphorescence may be due to light-emitting bacteria. One of the most striking features connected with phosphorescence is the simplicity of the mechanism by which it is produced and the entire absence of heat. "Thus," writes the author, "the light of a firefly, or a Pholas, has no sensible heat, whereas a temperature approaching 2000° F. would be necessary to make it by the usual processes, except the Geissler tube. So impressed were Prof. Langley and Mr. Very with this feature that they contrast it with the enormous waste in all industrial methods of producing light. . . . The authors, in view of this remarkable light without heat of the animals just considered, are of opinion that there is yet hope of obtaining an enormously greater result than we do now in the production of light."

BULLETINS Nos. 31, 32, and 33 (May and June, 1905) of the Bureau of Government Laboratories, Manila, have reached us. Bulletin No. 31 contains notes on a case of hæmatochyluria with observations on the embryo nematode, *Filaria nocturna*, by Drs. Wherry and McDill, and a research on the indol and cholera-red reactions by Dr. Wherry. Bulletin No. 32 deals with amœbic dysentery and amœbiasis, three articles being contributed by Drs. Strong, Thomas, and Woolley and Musgrave. Bulletin No. 33, by Dr. Herzog, records further observations on fibrinous thrombosis in the renal vessels in bubonic plague. The bulletins are well printed and well illustrated, and contain contributions of importance to medical science.

THE *Bulletin of the Johns Hopkins Hospital* for January (xvii., No. 178) is an excellent number. Dr. Harvey Cushing contributes an interesting and well illustrated article on Dr. Garth, the "Kit-Kat" poet. Garth was the single medical member of the famous Kit-Kat Club, and besides being distinguished in his profession and delivering the Gulstonian lectures and Harveian oration at the Royal College of Physicians, London, published many poems, the most important of which is "The Dispensary." Born in 1661, he died in 1718, and is buried at Harrow. Other articles are the relationship of the State to the tuberculosis question, by Dr. John Foster; a method of estimating the opsonic content of the blood, by Drs. Simon and Lamar; tropical splenomegaly, by Drs. Musgrave, Wherry, and Woolley; reports of societies, reviews, notes, &c.

THE Bulletin of the Department of Agriculture, Jamaica, for December, 1905, contains articles on rubber cultivation relating the progress made in Ceylon and south India, also a caution to planters with reference to the appearance of a cocoa disease caused by the fungus *Phytophthora omnivora*.

FROM the review of the teak timber trade in Burma, contributed by Mr. T. A. Hauxwell to the *Indian Forester* (November, 1905), it is seen that in the last fifteen years imports from Burma into Europe have diminished about 50 per cent., and prices have risen from 11*l*. to 15*l*. per ton; imports to India, where the standard of requirement is lower, show only a small decrease. The timber is extracted either by Government agency or by private lessees, the advantages in the latter case being that all marketable produce is extracted, and that the lessees have to share the risks, in connection with which the cost of elephants is a serious item.

IN the British West Indies, Jamaica easily leads the way in the cultivation of tobacco, but Trinidad also received an award at the recent Colonial and Indian Exhibition, and it is probable that good results may be obtained in certain parts of the other islands. A useful handbook to the cultivation and curing of tobacco has been issued by the Imperial Department of Agriculture as No. 38 of the pamphlet series. Mr. T. J. Harris gives a detailed and practical account of cultivation in the open and of curing the leaf, based on his former experience at the Hope Gardens, Jamaica, and Mr. W. N. Cunningham, who succeeded him, writes on tobacco-growing under shade.

OUR knowledge of the manner in which plants can receive external stimuli has been greatly extended by recent work, notably by the researches of Prof. Haberlandt. It is interesting to find that Prof. Schwendener has recorded his views on the subject in *Naturwissenschaftliche Wochenschrift* (January 2). In connection with the statolith theory of geotropism, a neat experiment is adduced as proof that can easily be put to the test. Ordinarily, if the root of a seedling is placed horizontal, curvature will ensue only after a definite lapse of time; assuming that starch grains take some time to react, it may be possible to reduce the interval by shaking or tapping the root. *Fiat experimentum.* The article also discusses the focusing action of certain epidermal cells of the leaf, and the mechanical feelers in the shape of hairs or papillæ that are possessed by insectivorous plants, the stamens of Berberis, and of the Cynareæ.

IN the *Proceedings of the American Academy of Arts and Sciences* for December, 1905, Mr. A. L. Rotch gives an account of the first observations with registration balloons in America. Although the successful experiments at Blue Hill led to the extensive use of kites for meteorological observations in other countries, unmanned balloons were not employed in America until 1904, when the author was enabled to make a series of four ascents at St. Louis in September of that year; at the maximum height, $10\frac{1}{2}$ miles, a temperature of $-62°.5$ F. was recorded. Another series of ten ascents was made in the latter part of November and the first part of December, mostly after sunset, to avoid possible effects of insolation. Two of these balloons travelled with a mean velocity of more than a hundred miles an hour. An extreme height of nearly 10 miles was attained, with a temperature of $-72°.4$ F.; and a reading of $-76°.2$ was once recorded somewhat below 7 miles. In order to continue these observations during the winter, Mr. Rotch made a further series of nine ascents during the latter part of January, 1905. On January 25 the extraordinarily low temperature of $-111°$ F. was registered at the height of about 9 miles, during the prevalence of a high barometric pressure at the ground. A complete publication of the results will be made in the Annals of the Astronomical Observatory of Harvard College.

An interesting pamphlet on the climate of St. Moritz has been published by Dr. A. Nolda, resident physician, with the collaboration of Mr. C. Bührer, director of the meteorological station at Montreux. The object of the paper is to show the claim of St. Moritz to be considered as a desirable health resort, and the meteorological statistics in support of this view are taken from those published by the Swiss Meteorological Institute in 1890–1 and 1900–4 inclusive; they are therefore entirely trustworthy. The village of St. Moritz is in the valley of the Upper Engadine, and the meteorological station has an elevation of 6040 feet. The characteristic features claimed for the station are:—a dry air, clear sky, high solar radiation, low humidity and rainfall, and almost complete immunity from summer and winter fogs; these advantages seem to be fully borne out by the official meteorological reports. The mean monthly temperatures are:—January, 19°·7 F.; July, 53°·8; the mean monthly extremes are:—January, −2°·5, 39°·7; July, 39°·9, 72°·7; the absolute extremes:—January, −15°·1, July, 76°·8. The mean annual humidity is 67 per cent.; on some days the atmospheric moisture falls to a point unknown in the lowlands of temperate latitudes; in 1900–4 instances are recorded of 10 per cent. to 16 per cent. The mean annual rainfall is 35·2 inches; rain and snow fall on an average on 128 days, and if we deduct the days when less than 0·04 inch fell, only 104 really rainy days remain. Compared with other places this is a very small number.

A copy of the *University of Colorado Studies* (vol. iii., No. 1), has reached us, containing brief historical, literary, psychological, and sociological articles by members of the university staff, a paper on extinct glaciers of Colorado by Mr. Henderson, and contributions to the natural history of the Rocky Mountains by Prof. T. D. A. Cockerell, in which several new insects and plants are described.

We have received reprints, from the Bulletin of the Museum of Comparative Zoology at Harvard (Geological Series, vol. viii., Nos. 1 and 2), of two papers by Prof. W. M. Davis. One, on the Wasatch, Canyon, and House Ranges, Utah, is a continuation of a paper on the mountain ranges of the Great Basin. The other deals with the glaciation of the Sawatch Range, Colorado.

The *Engineering and Mining Journal* of New York for January 6 contains carefully estimated statistics, compiled by prominent authorities, of production of the more important ores, minerals, and metals in the United States during 1905. The productions of iron, copper, lead, zinc, gold, and silver have all increased over 1904, and the outputs have been the highest recorded.

The introduction of reinforced cement marks a new epoch in the history of building, and an interesting account of some of the results achieved is given in the *Journal of the Franklin Institute of Philadelphia* for January. One of the most remarkable applications is the use of reinforced cement for the construction of dams. This method of building a permanent masonry dam at a comparatively low cost has already rendered financially practicable the utilisation of many water-power sites which otherwise would have been neglected.

In the *Bulletin de la Société d'Encouragement* of December 31, 1905, Dr. L. Guillet gives the results of a careful study of the nickel-vanadium steels. He prepared at the Imphy Steel Works nickel-steel alloys containing 0·2 per cent. and 0·8 per cent. of carbon, and of each series he selected a pearlitic steel, a martensitic steel, and a γ-iron steel, to which he added vanadium in proportions varying from 0·2 per cent. to 7 per cent. The effect of the addition of vanadium is to increase the elastic limit, very considerably in the case of the pearlitic steels. In other cases the increase is insignificant.

We have received from Mr. C. F. J. Galloway a useful paper contributed by him to the *Proceedings of the South Wales Institute of Engineers* (vol. xxiv., No. 6). It describes an application of the Brandt carriage and hydraulic column, successfully employed with hydraulic rock drills in the Simplon Tunnel, at a colliery in South Wales in conjunction with compressed-air rock drills. It proved one of the simplest and best forms of carriage for rock drills hitherto used. Full details of the work done and of the cost of the whole equipment are given.

In the *Transactions of the Institution of Engineers and Shipbuilders in Scotland* (vol. xlix., part iii.) there is an interesting paper by Mr. R. M. Neilson on the evolution and prospects of the elastic fluid turbine. Steam is not the only possible elastic fluid for a turbine; and the much greater ranges of temperature with the same range of pressure obtainable by the employment of other fluids instead of, or in conjunction with, steam deserve serious consideration. Much time has been spent on matters relating to elastic fluid turbines, and a large proportion of it has been devoted to inventions intended to be of a revolutionary nature with little knowledge of what had already been tried by others. The historical sketch of elastic fluid turbines given by the author is consequently most instructive. After an account of the early machines deserving the name of turbine, he describes and illustrates the turbines of Kempelen (1784), Gilman (1837), Wilbrow (1843), Wilson (1848), Fernihough (1850), Wertheim (1877), and De Laval (1882, 1889). The descriptions given of the turbines at present constructed show that although they differ among themselves very considerably, there is a visible tendency of the different types to approach each other. The preliminary experimental stage of the gas turbine has not yet been passed, and it cannot at present be said whether or not it ever will. An efficient gas turbine, which is a turbine both as regards the motor and the pump, seems to depend upon the obtaining of an efficient turbine compressor, or other form of rotary pistonless compressor. In order to determine whether the gas turbine had any reasonable chance of success in the near future, experimental research was needed as to the losses in pneumatic compression to high pressures, the expansion of hot gases in divergent nozzles, the transference of heat from gases to metals at high temperatures and very high velocities, and the oxidation of turbine blades when exposed to the action of air, steam, and carbon dioxide at high temperatures.

In several notices in these columns attention has been directed to the necessity of investigating mathematically the motions of aëroplanes and aërocurves as affording the only effective method of dealing with the problem of stability. A remarkably complete investigation on these lines is given in the *Revue d'Artillerie* for October and November, 1905, by Captain Ferber, who has been assisted in some of the calculations by M. Maillet. The method of treating the problem of longitudinal stability by considering the small oscillations about a steady state had been previously worked at (Bryan and Williams, *Proc. Roy. Soc.*, vol. lxxiii.), but owing to the appointment of the second of these authors to a research studentship, want of time rendered further progress impossible. The problem was then taken up by Captain Ferber, of the French

Artillery, who has given a masterly discussion of not only longitudinal but also lateral stability, and has arrived at a large number of important simple and practical conclusions relating to both the conditions of stability and the trajectories of aëroplanes the motion of which is stable. The paper constitutes by far the most important recent advance in the study of artificial flight.

MESSRS. PERCIVAL MARSHALL AND CO. have published a popular essay entitled "Electric Power. What it is and what it can do," by Mr. Alfred W. Marshall. The price of the pamphlet is 3*d*. net.

MR. NASARVANJI JIVANJI READYMONEY has issued a revised edition of his "Nature-history Museum and Descriptive defining Nature-history Tables," the first edition of which was noticed in our issue for March 30, 1905. Several changes and additions have been made in this painstaking piece of work.

Nos. 16, 17, and 18 of "Materials for a Flora of the Malayan Peninsula," by Sir George King, F.R.S., and Mr. J. Sykes Gamble, F.R.S.—which Messrs. West, Newman and Co., of Hatton Garden, are reprinting from the *Journal of the Asiatic Society of Bengal*—have been received. In addition to an account of the rubiaceous genus Psychotria, the first fasciculus contains descriptions of the Malayan members of eleven natural orders, including 48 genera and 81 species, of which two genera and 17 species are new to science. The second of the present parts describes five natural orders, Myrsinaceæ, Sapotaceæ, Ebenaceæ, Styraceæ, and Oleaceæ. These five orders comprise 24 genera and 221 species. There are no new genera, but the number of new species reaches 103. The last of the three instalments deals with nine natural orders containing 53 genera and 150 species, none of which are described for the first time. Among the orders of which accounts are given may be mentioned Boragineæ, Convolvulaceæ, Solanaceæ, Scrophulariaceæ, and Lentibulariaceæ. When all the fasciculi are available, we hope to review the complete work.

THE Cambridge University Press is publishing, under the title of "Cambridge Tracts in Mathematics and Mathematical Physics," a series of short works on various topics in pure mathematics and theoretical physics. The chief purpose of the undertaking is to assist in the maintenance of a high standard in English mathematical teaching by the continued infusion of new methods and more accurate modes of treatment, and by the extension of knowledge of recent mathematical research. The first of the series, a tract on "Volume and Surface Integrals used in Physics," by Mr. J. G. Leathem, has already been published, and a second, on "The Integration of Functions of a Single Variable," by Mr. G. H. Hardy, will be issued very shortly. The Press has also ready for immediate publication a new and revised edition, in one volume, of Prof. A. E. H. Love's "Treatise on the Mathematical Theory of Elasticity," and a third edition of Prof. Horace Lamb's "Hydrodynamics."

THE fourth year-book, that for 1905, of the Carnegie Institution of Washington has been received. The titles alone of the publications bearing upon the work done under grants from the institution fill eight closely printed pages, and it is impossible here to do more than direct attention to a few of the researches of outstanding importance. Prof. G. E. Hale, as director of the solar observatory at Mount Wilson, California, provides an excellent illustrated account of the astrophysical work done at Mount Wilson under his supervision. Prof. Lewis Boss, director of the Dudley Observatory, Albany, New York, describes his investigations of stellar motion. Mr. Charles B. Davenport, who is in charge of the station for experimental evolution at Cold Spring Harbour, New York, classifies the work in progress there, which is largely what he describes as of the "time-consuming" order, and gives a full report, with illustrations and results, of the experiments conducted during the year. Marine biology is well represented in the year-book by Mr. A. G. Mayer's account of what has been accomplished in connection with the laboratory at Tortugas, Florida. This report includes contributions from the numerous experts working in the laboratory. Several investigators were at work in the Desert Botanical Laboratory, Tucson, Arizona, and substantial progress in numerous directions was made during the year. Prof. T. C. Chamberlin, of the University of Chicago, continues his contributions to solutions of the fundamental problems of geology, and gives a full discussion of the deformations of the earth and of climatic oscillations. Mr. Bailey Willis, of the U.S. Geological Survey, describes his geological studies in Europe, and his attempts to determine the geographical condition of each continent at successive geological epochs. The magnetic survey of the North Pacific Ocean, undertaken by the U.S. Department of Research in Terrestrial Magnetism, and carried out by Mr. J. E. Pratt's party in the *Galilee*, is described by Dr. L. A. Bauer. These annual reports should be a source of gratification to Mr. Carnegie, and it is to be desired that wealthy men in this country could be led to follow an excellent example in the direction of encouraging scientific research and providing for the publication of results.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c* (GIACOBINI).—The following is a continuation of the ephemeris published in No. 4067 of the *Astronomische Nachrichten* by Herr A. Wedemeyer:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log r	log Δ
Feb 8 ...	23 31 16 ...	−21 9 ...	9·7704 ...	0·0694
10 ...	23 49 14 ...	−19 40 ...	9·8058 ...	0·0755
12 ...	0 5 58 ...	−18 7 ...	9·8379 ...	0·0830
14 ...	0 21 33 ...	−16 33 ...	9·8672 ...	0·0918
16 ...	0 36 3 ...	−14 59 ...	9·8942 ...	0·1016
18 ...	0 49 32 ...	−13 26 ...	9·9192 ...	0·1123

The accompanying chart shows, approximately, the apparent path of the comet among the stars from

FIG. 1.—Apparent path of Comet 1905 *c* (Giacobini), February 7–18, 1906.

February 7 to February 18, according to the above ephemeris.

Although still fairly bright, the comet is a difficult object

owing to its close proximity to the sun, and should be looked for immediately after sunset in the south-west quadrant, near to the horizon.

COMET 1906a.—Numerous observations of the new comet discovered by Mr. Brooks at Geneva, U.S.A., have been made, and from the positions determined on January 28, 29, and 30, the following elements and an ephemeris, of which a part is given below, have been calculated by Messrs. Crawford and Champreux:—

Elements.

T = 1905 Dec. 19·47 G.M.T.

$$\left.\begin{aligned} \omega &= 86^\circ\ 22' \\ \Omega &= 285\ 27 \\ i &= 126\ 49 \end{aligned}\right\}\ 1906{\cdot}0$$
$$q = 1{\cdot}2826$$

Ephemeris 12h. G.M.T.

1906	α (h. m.)		δ (° ′)		Brightness
Feb. 8	15 50·4	...	+70 37	...	1·04
,, 12	15 05·9	...	+78 37	...	1·05

Brightness at time of discovery = 1·0.

Thus it will be seen that the comet is now travelling due north, and is easily circumpolar, but it is in a better position for observations after midnight (Kiel *Circular*, No. 85).

A NEW METHOD OF DETERMINING THE MOON'S POSITION PHOTOGRAPHICALLY.—The chief difficulty in photographically recording the moon's position among the stars, for the purpose of determining the errors in the ephemeris, arises from the fact that if the exposures be long enough to record the faint, surrounding stars, the moon's image is tremendously over-exposed, and the star images are lost in the light-fog caused by the prevailing moonshine. Several methods of overcoming this difficulty have been proposed, and Mr. Wade, of the Helwan Observatory, Egypt, now suggests another, which, from his preliminary experiments, promises to be successful.

In this method the camera is mounted so that its optical axis passes horizontally through the centre of an ordinary cœlostat, but the mirror of the latter, instead of being worked to a true plane, is figured as a prism, the two faces of which are inclined at an angle of $7\frac{1}{2}^\circ$, and the edge of the prism is arranged parallel to the polar axis. Thus the photograph obtained includes two fields which are, actually, separated by 15° in right ascension.

The cœlostat is arranged so that one face of the prism reflects the moon's image into the camera, whilst the other face reflects the field of stars situated about 1 hour in right ascension from the moon, and therefore beyond the range of strong moonlight. Then the reflected lunar image is intercepted whilst the reflected star images are exposed for $2\frac{1}{2}$ minutes, when an instantaneous exposure on the moon is made. The operation is completed by exposing the star-field for a second $2\frac{1}{2}$ minutes. By this method Mr. Wade has obtained a number of successful negatives with a 2-inch visual achromatic Dallmeyer lens and a cœlostat of 4 inches diameter (*Monthly Notices Royal Astronomical Society*, vol. lxvi., No. 2).

A CATALOGUE OF SPECTROSCOPIC BINARIES.—A novel and important catalogue, published by the Lick Observatory as Bulletin No. 79, has just been received. It contains all the known particulars of the orbits of the spectroscopic binary stars discovered prior to January 1, 1905.

On that date 140 of these objects were known, 72 of them having been discovered by the Lick observers and 41 at the Yerkes Observatory.

When one remembers that the first of these interesting objects, ζ Ursæ Majoris, was discovered by Prof. Pickering so recently as 1889, it becomes evident that this field of research is likely to contain ample scope for further work; therefore in order to simplify matters for future observers Prof. Campbell and Dr. H. D. Curtis have collected all the known results into the present catalogue. In addition to the positions, magnitudes, spectral types, and orbital details of the binaries, the catalogue contains a valuable column in which the name of the discoverer and references to the bibliography of each binary, together with brief notes, are given.

OBSERVATIONS OF THE LYRID METEORS, APRIL, 1904.—In No. 4067 of the *Astronomische Nachrichten* Dr. Jiří Kaván, of the Prag-Smichow Astronomical Institute, gives the results of his observations of the Lyrids on April 18, 19, 20, and 21, 1904.

Forty-five meteors were observed, twenty of them being recorded between 12h. 5m. and 15h. 25m. (M.E.T.) on April 19. From an analysis of the records, Dr. Kaván has deduced two radiant points for this shower as follows:—

(1) $\alpha = 278^\circ{\cdot}0$ ... $\delta = +30^\circ{\cdot}5$ (near β Lyræ)
(2) $\alpha = 247{\cdot}0$ ... $\delta = +31{\cdot}5$ (near ζ Herculis).

REPORT OF THE MEETING OF THE SOLAR COMMISSION AT INNSBRUCK.

THE commission was constituted by the following action of the Southport meeting of the International Meteorological Committee thus reported:—

"Discussion of the relation of meteorology to astrophysics."

"The members of the Committee had previously taken part in a discussion of this subject at a meeting of Section A of the British Association; and Mr. Shaw proposed that a Commission should be appointed to review and discuss meteorological observations from the point of view of their connection with solar physics. Mr. Shaw's motion was adopted, and MM. Lockyer, Shaw, Pernter, and Angot were elected to serve on this Commission with power to add to their number and to elect their officers."

The following is the list of those who have been appointed members of this commission up to the present time:—

M. A. Angot, Bureau Central Météorologique, Paris.
Prof. H. J. Ångström, University, Upsala.
Geheimrat oberregierungs von Bezold, Berlin.
M. Teisserenc de Bort, Observatoire de Trappes, prés Paris.
Prof. F. H. Bigelow, Weather Bureau, Washington.
Prof. Birkeland, University of Christiania.
Rev. G. R. Cirera, S.J., Observatorio del Ebro, Tortosa, Spain.
Dr. W. G. Davis, Oficina Meteorologica Argentina, Cordoba, Argentine Republic.
M. H. Deslandres, Observatoire d'Astronomie physique, Meudon, Seine et Oise.
Sir John Eliot (secretary), 79 Alleyn Park, Dulwich, London; Bon Porto, Cavalaire, Var, France.
Mr. G. E. Hale, Solar Observatory, Mount Wilson, California, U.S.A.
Hofrat Prof. Dr. J. Hann, 19 Hohe Warte, Vienna, Austria.
M. M. S. Hepites, Institut Météorologique, Bucarest, Roumania.
M. Janssen, Observatoire d'Astronomie physique, Meudon, Seine et Oise.
Prof. W. H. Julius, Rijks Universiteit, Utrecht, Holland.
Hofrat. Prof. Dr. N. Thege v. Konkoly, k. meteor. Reichsanstalt, Budapest.
Prof. Dr. W. Köppen, Seewarte, Hamburg.
Mr. S. P. Langley, Secretary of the Smithsonian Institution, Washington, U.S.A.
Sir Norman Lockyer (president), Solar Physics Observatory, South Kensington, London.
Dr. W. J. S. Lockyer, Solar Physics Observatory, South Kensington, London.
Captain J. H. Lyons, R.E., Survey Department, Cairo, Egypt.
M. E. Marchand, Observatory, Pic du Midi.
Prof. H. Mohn, Meteorologische Institut, Christiania.
Hofrat. Prof. Dr. J. M. Pernter, Hohe Warte, Vienna, Austria.
Prof. Riccò, University of Catania, Sicily, Italy.
Prof. G. B. Rizzo, University of Messina, Sicily, Italy.
Mr. A. L. Rotch, Blue Hill Meteorological Observatory, Cambridge, Mass., U.S.A.
Sir Arthur Rücker, 19 Gledhow Gardens, London, S.W.

General Rykatcheff, St. Petersburg, Russia.
Prof. Dr. J. Scheiner, Konigl. Friedrich Wilhelms Universität, Berlin.
Dr. W. N. Shaw, Meteorological Office, 63 Victoria Street, London.
M. A. Silvado, Direction de Meteorologia, Morro de St. Antanis, Rio de Janeiro, Brazil.
Prof. A. Steen, Meteorological Institute, Christiania.
Mr. R. F. Stupart, Canadian Dominion Meteorological Service, Toronto.
Prof. J. Violle, Conservatoire des Arts et Métiers, Paris.
Prof. Dr. C. H. Wind, University of Utrecht, Holland.
Prof. A. Woeikoff, St. Petersburg, Russia.
Prof. Dr. Max Wolf, Grossherz Ruprecht-Karls Universität, Heidelberg, Germany.
Prof. A. Wölfer, Zurich Observatory, Switzerland.

At a meeting at Cambridge in August (18–23), 1904, Sir Norman Lockyer was elected president and Sir John Eliot secretary.

A provisional programme was considered, and the following resolutions were passed or action taken :—

A letter received from Mr. Hale respecting the cooperation of the Commission with the Committee on Solar Research of the National Academy of Sciences was read, and it was agreed to cooperate with the Committee on questions of common interest.

Upon the initiation of the Committee a union was formed for the study of solar phenomena, and Dr. W. J. S. Lockyer was appointed later by correspondence to attend the meeting of this union at Oxford in September, 1905, as the representative of the Commission.

A scheme of solar observations was approved.

It was resolved (1) that in connection with the observations of solar radiation, observations of the transparency of the air would be desirable, more especially (*a*) on the visibility of distant and high mountains when possible; and (*b*) photometrical observations of Polaris.

The following resolutions were passed :—

(1) That, in the first instance, for the purpose of comparison with solar phenomena, the meteorological observations to be considered should be monthly means of pressure, temperature (including maximum temperature and minimum temperature) and rainfall.

(2) That the members of the Commission be requested to communicate to the secretary a short report of the data available in their respective countries, and the number of years over which they extend.

(3) That a circular be addressed to the various meteorological organisations asking them to send to the secretary, for the purposes of the Commission, a copy of the publications of their offices embodying the data specified in the two preceding resolutions, and that the organisations be also requested to obtain and forward copies of similar publications from the colonies and dependencies of their respective countries.

(4) That the Commission considers it is desirable that the data for the purposes of comparison should be sent to the president of the Commission, South Kensington (Solar Physics Observatory), for tabulation and comparison. The Commission attaches the greatest importance to this work, more especially as it may lead to a practical system of long-period forecasting, and hopes that if it be necessary, an increase of staff at that observatory may be authorised to bring all old observations up to date.

(5) That the establishment of magnetical observatories in about lat. 70° N. (*e.g.* Bosskop, in Norway) and in very high latitudes of the southern hemisphere is of the highest importance for the advancement of science.

Prof. Riccò informed the Commission that it is intended to establish in Italy or Sicily a magnetic observatory with self-recording instruments belonging to the Italian Meteorological Office.

It was agreed that all communications for the Commission should be received at a central address, viz. the Solar Physics Observatory, South Kensington.

At the meeting at Innsbruck, September 11–15, 1905, the following resolutions were adopted :—

(1) That for the sake of brevity the name of the Commission be the Solar Commission of the International Meteorological Committee.

(2) That the secretary be instructed to report the proceedings of the meetings of the Commission held at Cambridge in August, 1904, and at Innsbruck in September, 1905, to the International Meteorological Committee, and to ask that it will take the proper steps to bring their suggestions before the International Association of Academies.

(3) Que pour la pression et la temperature les chefs des différents services météorologiques soient priés de preparer une liste des stations qu'ils considèrent comme suffisantes pour bien representer les différents régimes météorologiques que existent dans leur pays.

(4) Que dans le nord de Siberie et le nord de l'Amerique soient organizés des stations permanentes météorologiques au moins deux ou trois sur chaque continent.

La Commission exprime le desir de recevoir communication des observations des îles dont les noms suivent;[1] insiste sur l'utilité d'assurer la permanence des observations météorologiques dans ses regions, et prie son président de faire par intermédiaire du Comité international des Académies officiellement auprès des divers gouvernements les démarches necessaires pour que des observations météorologiques soient organizés et maintenues dans les stations mentionées ou ces observations n'existent pas d'une manière regulière et permanente.

A form was prepared and approved for the tabulation of the pressure, rainfall and temperature data.

Pour le but que poursuit la Commission, il est désirable que dans toutes les stations, les valeurs normales soient déduites des *mêmes* années (20, 25, ou plus) le millésime de la première année se terminant par 1 ou 6 d'après les recommendations du Congrès météorologique international de Vienne.

The normal period selected for comparison when possible is the twenty-five year period from 1881 to 1905.

M. Angot presented a selected list of stations for France which the Commission decided should be utilised in the circular as an example of the requirements of the Commission. In connection with this selection it was decided that the proportion of mountain stations to plain stations in any country should not exceed one to four.

The questions of magnetic and rainfall data were taken up, and it was resolved

(1) That the Magnetic Commission should be asked to assist the Solar Commission in the selection of magnetic observatories, and to advise as to the amount and extent of information which these observatories would be able to give in order to assist in the investigation of the relations of solar and terrestrial meteorology.

(2) That the suggestion of Mr. Langley that ten-day means as well as monthly means be employed be referred to the Magnetic Commission for opinion.

General Rykatcheff, president of the Magnetic Commission, read a communication in reply to the request mentioned above :—

" Décision de la Commission magnétique par rapport à la demande de la Commission solaire.

" La Commission magnétique a pris certaines décisions qui entrent dans les rues de la Commission solaire, celles sont les décisions sur la publication des courbes troublées, sur les listes des jours calmes et troublés, sur les coefficients exprimant l'activité magnétique de chaque jour et sur la publication d'une liste d'observatoires magnétiques.

La Commission magnétique décide que toutes ces publications seront communiquées aux membres de la Commission solaire.

" Si la Commission solaire trouverait que d'autres données, que celles enumerées tout à l'heure sont désirables, la Commission magnétique se déclare prête à collaborer avec la Commission solaire en la priant toutefois de vouloir bien presiser ses desirs !

" Quant à la question des moyennes par decades la Commission estime que cette question ne peut être resolu que par le comité des directeurs, auquel elle sera remise.

" La Commission magnétique estime qu'il serait bien de diriger l'attention du futur Bureau permanent magnétique sur les demandes de la Commission solaire."

(3) Pour le moment on se contente de demander les données relatives à la pluie aux stations que fournissent déjà celles de la temperature et de la pression; on pourra

[1] The complete list will be given later in the official report of the meeting of the Commission.

ultérieusement étendre le nombre des observations pluviométriques si la necessité s'en fait sentir.

(4) Les chefs des services météorologiques et hydrographiques sont priés d'ajouter aux données météorologiques envoyées à la Commission, autant de données sur la niveau et la debit des rivières et des lacs qu'ils croirent possibles et utiles.

(5) That the secretary be asked to prepare a regional statement of rainfall for India as an example of what the Commission desires in the way of reports of regional rainfall and variation of rainfall for each meteorological organisation.

Instructions were given to Dr. W. J. S. Lockyer for his action as representative of the Commission at the Oxford meeting of the Solar Research Union.

It was resolved that while thanking the Washington Weather Bureau for its courteous offer to publish in the Washington *Monthly Weather Review* the data collected by the Commission, the Commission is not yet in a position to decide upon the most appropriate form of publication.

It was decided that a circular should be sent to the various meteorological organisations in the following terms:—The Commission desire to direct attention to the concluding paragraph of Prof. Violle's report to the International Meteorological Committee, 1903, and would be greatly obliged if the Commission could be informed of the arrangements for observing solar radiation adopted at the observatories of the various meteorological organisations and the methods employed to render the observations comparable with those of other observatories.

A first list of places at which actinometric observations are made was presented.

It was resolved that "une circulaire sera envoyé aux directeurs des services météorologiques pour leur demander de designer les stations de leur pays ou les observations actinométriques sont regulièrement faites. Dans le liste des stations il serait utile d'éviter les grandes villes ou les conditions atmospheriques sont generalment défectueuses."

That steps should be taken to obtain observations from the places mentioned.

La Commission Solaire prie M. le Président de vouloir bien obtenir les courbes de la distribution de l'energie solaire pour les observatoires qui ont déjà l'obligéance de communiquer les autres données indiqués dans les Comptes rendus des Seances de la Conférence de Cambridge, à propos de la physique solaire.

ANTHROPOLOGICAL NOTES.

L'ANTHROPOLOGIE usually devotes much space to archæology, and the recent number (vol. xvi., Nos. 4–5) contains three papers on that subject. Mr. H. Obermaier gives the first instalment of a most useful memoir on Quaternary human remains and the sites in Central Europe where they have occurred. Mr. A. Viré describes a prehistoric cave of the Solutré period at Lacave (Lot); the human bones were too fragmentary to have any value. Mr. E. Cartailhac and Father Breuil continue their account of the mural paintings and engravings of the Pyrenean caves; they give several illustrations; as is usually the case among primitive peoples, the representations of human beings fall greatly below the excellence of animal delineations. The authors come to the conclusion that in the cave of Marsoulas the earlier engravings with linear contours are associated with black paintings, while the later engravings, in which the contours are made with short lines to indicate hair, are associated with polychromatic paintings of animals. In a paper on the myology of a Negro, Messrs. R. Anthony and A. Hazard state that muscles are thick and short, thus indicating strength rather than agility. Hunting and agriculture among the populations of the Sudan are the subjects of a paper by Mr. J. Decorse. Mr. L. G. Seurat describes the marae, or stone altars, of the little frequented eastern islands of the Tuamotu Archipelago. Mr. C. Monteil discourses on the numbers and numeration among the Mandés, a large linguistic family of people of western French Africa. The journal contains the usual valuable *résumé* of recent anthropological literature.

Two papers in the *Journal of the Asiatic Society of Bengal* (vol. lxxiii.) should not be overlooked. Mr. J. E. Friend-Pereira has discovered totemism among the Khonds, where the wider totemic exogamy has been hidden by the narrower and probably newer rule of the "local, communal, or family type." The "septs," as the author terms the totem groups, have the ordinary totem tabus of feeding, use and marriage, and myths of origin. He believes totemism "serves to mark to a primitive people who possess no written characters to record kinship and descent as they begin to get more remote in time the distinction between separate stocks of blood. In other words, totemism is merely a guide for the observance of the rules of exogamy: it is not the cause that originated or evolved these rules." He holds that the explanation of the origin of totemism must be sought for, not in its social, but in its religious aspect. Among the Khonds "the totem ranks as the spirit of the ancestor founder of the stock, who is also the chief tutelary deity of the stock, and the totem class is considered as a manifestation of the chief tutelary deity." Major P. R. T. Gurdon has a valuable short paper on the Khasis, Syntengs, and allied tribes of Assam, among whom mother-right so predominates that males can own only self-acquired property. There are traces of totemism. Ancestors are worshipped by the erection of remarkable memorial stones, of which two illustrations are given; this form of worship largely underlies the Khasi religious system. Divination by the breaking of eggs is very common. Major Gurdon is superintendent of ethnography in Assam, and is apparently preparing a monograph on the people under his charge which, judging from these notes, should be a valuable work.

The current number of the *Journal of the Anthropological Institute* (vol. xxxv., 1905) contains papers in all branches of anthropology. Physical anthropology is represented by a paper by Messrs. F. G. Parsons and C. R. Box on the relations of the cranial sutures to age, and by a critical paper by Dr. C. S. Myers traversing the conclusion of Miss Fawcett that in certain characters a progressive evolution has taken place in regard to the "prehistoric" and modern Egyptians. South African archæology has been much to the fore of late; the notes on the Great Zimbabwe elliptical ruin by Mr. Franklin White, and a paper on the stone forts and pits on the Inyanga Estate, Rhodesia, were written before Mr. Randall-MacIver's subversive views were published. Mr. T. W. Gann discourses on the ancient monuments of Honduras and on the natives now living there. In technology there is a beautifully illustrated paper by Mr. D. Randall-MacIver on the manufacture of pottery in Upper Egypt. Mr. N. W. Thomas enumerates the varieties of the canoes and rafts in Australia and their distribution. Mr. E. B. Haddon, in a well illustrated paper on the dog-motive in Bornean art, discusses the origin and degeneration of certain designs. Religion is represented by notes by Mr. R. E. Dennett on the philosophy of Bavili of Luango, West Africa. Finally, a report on the ethnology of the Stlatlumh, one of the Salish tribes of British Columbia, by Mr. C. Hill Tout, is a good example of a paper on regional ethnography. It will be seen that the journal maintains its high standard, both for the quality of its matter and the excellence of its illustrations.

A GAS CALORIMETER.

THE paper on a new gas calorimeter which was read before the Royal Society by Mr. C. V. Boys, F.R.S., on December 7, 1905, is of interest, partly on account of the causes which led to the design, and partly on account of the features which are original.

The agitation of the gas companies in favour of reducing the candle-power of gas on the ground that gas of lower candle-power is cheaper while the diminution of the light afforded by a luminous flame is of little consequence as incandescent lighting is so largely used, while it has succeeded in many cases in getting the statutory lighting power reduced, has on the other hand raised the question whether the value of the gas for heating purposes

and for power may not be reduced also, so that while the flame-lighting power may be reduced without much detriment, the consequent fall of heating-power may be a serious loss to the public. In the London Gas Act, 1905, such risk has been met by the obligation to test the calorific value of the gas for information only, but no penalties are incurred, even though the gas should prove to be of much less heating value than it has been.

The gas referees have therefore had the question of a suitable calorimeter before them, and in the "Notification" issued on January 1 (see p. 273) the calorimeter designed by Mr. Boys, who is one of them, is prescribed for use in official testings.

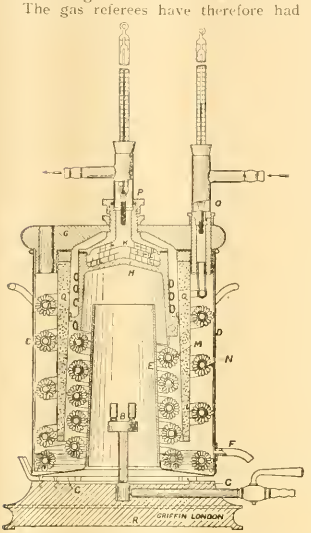


FIG. 1.

The calorimeter in question is of the Hartley type, *i.e.* a stream of water constantly passes through the instrument, and in so doing it is raised in temperature by the heat produced by the combustion of a stream of gas. The observations available enable the observer to ascertain the calorific value of the gas.

The best known instrument of this class is the Junker calorimeter, and it is in relation to this that the new features introduced by Mr. Boys are best described. From the accompanying figure it will be seen that the gas is burned at two small union jets instead of in the usual long Bunsen flame. The hot gases rising into the bell H descend outside the chimney E through the wires of the inner coil M. This and the outer coil N are made of the well known motor-car radiator tube invented by Mr. Clarkson. The circulating water enters the outer coil at the union O, and leaving the inner coil enters the space above the bell H, where it circulates between two dished plates and then leaves at the union P. The two lower turns of the Clarkson tube are immersed in a condensed water bath with an overflow F, which may be turned in any direction. This water bath serves to keep the chimney cool enough not to burn, but not cool enough to cause condensation to occur on the inner surface. One result of this construction is the slow passage of the products of combustion through the instrument and the small resistance they encounter. Hence the instrument need not be more than a foot high. The circulation of the water through the instrument strictly in series in every part prevents the formation of pockets or streaks of warmer water and consequent spasmodic changes of the outlet thermometer reading, and such small changes as might remain are almost entirely destroyed in the temperature equalising chamber above the bell H. The result is that, with a rise of temperature of 23° C., the variations do not exceed two or three hundredths of a degree, and even this appears to be largely due to friction in the meter insufficiently corrected by the governor.

Five minutes after lighting the gas the outlet thermometer is within 6 per cent. of its ultimate rise; in ten minutes it is within 2·2 per cent., and in fifteen minutes it is less than ½ per cent. In this and other respects the gas examiner who will have to use the instrument will find that not only accuracy, but his convenience has been studied.

One feature is quite peculiar. While hitherto gas calorimeters have been soldered up so as to be of the nature of mystery boxes, this can be seen in its essential features, while it can be completely taken to pieces in a few minutes for examination of every part.

After use the coil system is lifted out of the outer vessel by the lid and is then immersed in a dilute solution of bicarbonate of soda, so as to neutralise the weak sulphuric acid condensed upon the metal and prevent it and its dissolved oxygen from prematurely destroying the metal-work of the coils. The instrument is made by Messrs. Griffin and Sons.

THE ELECTRIC PRODUCTION OF NITRATES FROM THE ATMOSPHERE.[1]

As the demand of the white races for wheat as a foodstuff increases, the acreage devoted to wheat growing increases, but at a less rapid rate; and being limited by climatic conditions will in a few years, perhaps less than thirty, be entirely taken up. Then, as Sir William Crookes pointed out in his presidential address in 1898, there will be a wheat famine, unless the world's yield per acre (at present about 12·7 bushels per acre on the average) can be raised by use of fertilisers. Of such fertilisers the chief is nitrate of soda, exported from the nitre beds in Chili. The demand for this has risen from 1,000,000 tons in 1892 to 1,543,120 tons in 1905, and the supply will at the present rate be exhausted in less than fifty years. Then the only chance of averting starvation lies, as Crookes pointed out, through the laboratory.

In 1781, Cavendish had observed that nitrogen, which exists in illimitable quantities in the air, can be caused to enter into combination with oxygen, and later he showed that nitrous fumes could be produced by passing electric sparks through air. Although this laboratory experiment had undoubtedly pointed the way, though the chemistry of the arc flame had been investigated in 1880 by Dewar, and though Crookes and Lord Rayleigh had both employed electric discharges to cause nitrogen and oxygen to enter into combination, no commercial process had been found practical for the synthesis of nitrates from the air until recently.

After referring, in passing, to the tentative processes of Bradley and Lovejoy, of Kowalski, of Naville, and to the cyanamide and cyanide processes, attention was directed to the process of Birkeland and Eyde, of Christiania, for the fixation of atmospheric nitrogen, and their synthetic production of nitrates, by use of a special electric furnace. In this furnace an alternating electric arc was produced at between 3000 and 4000 volts, but under special conditions which resulted from the researches of Prof. Birkeland, the arc being formed between the poles of a large electromagnet, which forced it to take the form of a roaring disc of flame. Such a disc of flame was shown in the lecture theatre by a model apparatus sent from Christiania. In the furnaces, as used in Norway, the disc of flame was 4 feet or 5 feet in diameter, and was enclosed in a metal envelope lined with firebrick. Through this furnace air was blown, and emerged charged with nitric oxide fumes. These fumes were collected, allowed time further to oxidise, then absorbed in water-towers or in quicklime, nitric acid and nitrate of lime being the products. The research station near Arendal was described, also the factory at Notodden, in the Hitterdal, where electric power to the extent of 1500 kilowatts was already taken from the Tinnfoss waterfall for the production of nitrate of lime. This product in several forms, including a basic nitrate, was known as Norwegian saltpetre. Experiment had shown that it was equally good as a fertiliser with Chili saltpetre, and the lime in it was of special advantage for certain soils. The yield of product in these furnaces was most satisfactory, and the factory at Notodden—which had been in commercial operation since the spring of 1905—was about to be enlarged; the neighbouring waterfall of

[1] Abstract of a discourse delivered at the Royal Institution on Friday, February 2, by Prof. Silvanus P. Thompson, F.R.S.

Svaelgfos being now in course of utilisation would furnish 23,000 horse-power. The Norwegian company had further projects in hand for the utilisation of three other waterfalls, including the Rjukanfos, the most considerable fall in Telemarken, which would yield more than 200,000 horse-power. According to the statement of Prof. Otto Witt, the yield of the Birkeland-Eyde furnaces was more than 500 kilograms of nitric acid per year for every kilowatt of power. The conditions in Norway were exceptionally good for the furnishing of power at exceedingly low rates. Hence the new product could compete with Chili saltpetre on the market, and would become every year more valuable as the demand for nitrates increased, and the natural supplies became exhausted.

POLAR EXPLORATION.

After discussion at a meeting of explorers and geographers interested in the study of the polar regions, a statement was submitted to the congress held at Mons in September, 1905, setting forth the expediency of founding an International Association for the Study of the Polar Regions, with the objects of "(1) obtaining an international agreement upon different questions associated with polar geography; (2) making a general effort to reach the terrestrial poles; (3) organising expeditions having for their object an extension of our knowledge of the polar regions in every respect; and (4) forming a programme of scientific work to be carried out in the different countries during the existence of the International Polar Expeditions." The congress unanimously passed a resolution expressing the wish "(1) to see the formation of this Association in 1906 by a previous meeting of a general Conference of the larger scientific and maritime nations, who have taken part in the principal polar expeditions up to the present time; and (2) to see that the Belgian Government takes the initiative in approaching the Governments of other countries."

We have received a copy of a letter which has been addressed by M. Lecointe, to whom the congress entrusted the work of making the necessary preliminary arrangements, to the presidents of academies and of learned societies all over the world. It is proposed to hold the first conference at the beginning of May, for the consideration of general questions, and to discuss in detail "(1) the basis of a series of polar expeditions; (2) the programme of term of observations to be carried out in all the observatories; and (3) the text of the working arrangements of the International Association" at a second conference, composed of State delegates and delegates from academies and learned societies, in September. The conclusions arrived at by the second conference will be transmitted for examination to the Belgian Government, which eventually will ask the support of other countries for the new association.

In connection with the proposed International Association for the Study of the Polar Regions, M. Lecointe invites polar explorers to send him papers or notices dealing with questions which will be considered at the general conference in May next. A paper of the kind has been issued in which M. Henryk Arctowski makes a number of suggestions for work in the future. M. Arctowski expresses the opinion that in future Arctic research much use may be made of ice-breakers of the type of Makaroff's *Yermak*. With regard to Antarctic exploration, the settlement of the continental question is admittedly of primary importance, but M. Arctowski strongly urges the advisability of exploring thoroughly the circumpolar areas as a preliminary, especially by hydrographical expeditions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The recommendation of the Forestry Syndicate with regard to the general management of the examinations, the schedules of the proposed forestry examination, &c., passed the Senate last Thursday. The most important of these recommendations is that the general conduct of the examinations and the prescription of courses of training are to be entrusted to a committee of the Board of Agricultural Studies. Such a committee will include the professors of agriculture, botany, chemistry, and geology, and the reader in agricultural chemistry, together with three other members of the Board of Agricultural Studies. The committee will have the power to co-opt annually, if it thinks fit, four other persons.

The professor of experimental physics gives notice that a course of three lectures on "The Life-history of Surface Air Currents" will be given by Dr. W. N. Shaw, F.R.S., director of the Meteorological Office, in the Cavendish Laboratory on Wednesdays, February 14 and February 21, and Thursday, March 1.

London.—Prof. E. A. Minchin commenced at University College on Monday a course of lectures on "Parasitic Protozoa." Prof. Minchin recently returned from Uganda, where he was engaged as one of the special commissioners of the Tropical Diseases Committee of the Royal Society in research on the life-history of the trypanosome of sleeping sickness.

Prof. Drude has been elected rector of the Dresden Technical High School for the ensuing year.

During January, Dr. Bolam, lecturer on chemistry at Queen Margaret College, Glasgow University, delivered in Leith Nautical College a short course of lectures on "The Chemistry of Dangerous Cargoes" to large nautical audiences. Mr. James Currie (of Messrs. James Currie and Co.) presided, and pointed out the importance of the course in view of the very complex cargoes merchant ships were now carrying.

Mr. H. F. Trippel directs attention to an important point in connection with army entrance examinations in a letter to the *Pall Mall Gazette* of February 3. Mathematics is a compulsory subject for every candidate competing for admission to the Royal Military Academy, Woolwich; yet Mr. Trippel says that in the recent examination one of the competitors who scored zero in mathematics was placed among the successful candidates. It appears, therefore, that though it is compulsory to take mathematics in the competitive examination, a candidate may do so without having any serious intention of gaining a single mark in the subject. Now that the attention of the authorities has been directed to the defect in the regulations which permits this course to be followed, it is to be hoped that a minimum standard of marks to be gained in mathematics by all candidates will be prescribed, or some other remedy found.

SOCIETIES AND ACADEMIES.

London.

Geological Society, January 10.—Dr. J. E. Marr, F.R.S., president, in the chair.—The clay-with-flints: its origin and distribution: A. J. **Jukes-Browne.** Until recently the clay-with-flints has been regarded as being, in the main, a residue from the slow solution of the Chalk. Of late years, the opinion has been growing that it consists very largely of material derived from the Eocene. The present paper is devoted to an examination of the facts, with the view of ascertaining whether the clay-with-flints could possibly be derived from the Chalk, or whether the theory of its derivation from the Eocene is confirmed by more detailed inquiry. From several lines of investigation the author concludes (1) that the clay-with-flints cannot have been formed from mere solution of the Upper Chalk; (2) that all its components, except the unbroken and angular flints, could have been furnished by the Reading beds; (3) that the positions occupied by it are such that no great thickness of Chalk can have been destroyed to form it, the tracts being seldom more than 30 feet or 40 feet below the local plane of the Eocene base, or the presumed level of that plane.—Footprints from the Permian of Mansfield (Nottinghamshire): G. **Hickling.** These fossils were discovered in 1897 by Mr. Francis Holmes in the Rock Valley Quarry, Mansfield, in a local, lenticular mass of sandstone intercalated in the Magnesian Limestone. The prints present some resemblance to those named *Ichnium acrodactylum*, from the Upper Permian of Thuringia.

Zoological Society, January 16.—Mr. Howard Saunders, vice-president, in the chair.—Some bones of the lynx (*Felix lynx*) found in a limestone cavern in Cales Dale, Derbyshire: W. Storrs **Fox**. This was only the third record of remains of this species having been met with in the British Islands.—Mammals recently collected in the Malay Peninsula by Mr. C. B. Kloss, and presented to the National Museum: J. L. **Bonhote**. The collection contained examples of seventeen species, chiefly rodents, of which two, representing well known Bornean species, were described as new. There was also a series of *Mus jarak*, a species hitherto known from one specimen only, and recently described by the author.—The minute structure of the teeth of the creodonts: C. S. **Tomes**. The author stated that suggestions which had been made as to a possible relationship between the creodonts and the polyprotodont marsupials had rendered it interesting to see how far the structure of their teeth either supported or tended to disprove such speculations. Marsupial teeth possessed in the structure of their enamel a well marked peculiarity, namely, the free penetration of the epiblastic enamel by tubes continuous with those of the mesoblastic dentine, and it happened that recent Carnivora, the descendants, more or less direct, of the creodonts, also presented a disposition of the prisms of their enamel somewhat unusual amongst Mammalia. Teeth of Hyænodon, Sinopa, Oxyæna, Pachyæna, Borhyæna, Didynictis, and Cynodictis had been examined, and in none of them were marsupial characters observed; on the contrary, in most of them characteristic carnivorous patterns were found, so that in Oligocene and Eocene times their enamel had already attained to its full specialisations.—Contributions to the anatomy of the Ophidia: F. E. **Beddard**.—Synopsis of the toads of the genus Nectophryne, with special remarks on some known species and description of a new species from German East Africa: Dr. J. **Roux**.

Royal Meteorological Society, January 17.—Mr. Richard Bentley, president, in the chair.—Annual general meeting.—Address on meteorology in daily life: R. **Bentley**. The president referred to the increasing interest shown lately throughout the country in the study of meteorology, and to the recent advances which had been made in it—more especially in the analysis of the composition of the atmosphere—and in the investigation of the upper currents of the air. He also laid stress on the increasing urgency of safeguarding the water supply, and gave various illustrations of the effects of weather on human life, on the land, on navigation, on transit, &c.

Royal Microscopical Society, January 17.—Dr. D. H. Scott, F.R.S., president, in the chair, annual meeting.—Annual address, the subject being "The Life and Work of Bernard Renault": **President**.

Chemical Society, January 18.—Prof. R. Meldola, F.R.S., president, in the chair.—The refractive indices of crystallising solutions, with especial reference to the passage from the metastable to the labile condition: H. A. **Miers** and F. **Isaac**. The authors found that the refractive index of a strong solution of sodium nitrate, measured at intervals while the liquid cools, rises to a maximum value and then falls, crystals appearing before the maximum is reached. There are always two periods of crystallisation: a first, in which a few crystals are growing gradually; a second, in which many crystals appear spontaneously. The authors regard these as being undoubtedly the metastable and labile states.—The effect of constitution on the rotatory power of optically active nitrogen compounds, part i.: M. B. **Thomas** and H. O. **Jones**. The resolution of a set of optically active nitrogen compounds and the examination of the rotatory power of their salts in dilute aqueous solution have been made in order to find the rotatory power of the ions. The values of $[M]_D$ for some of the principal alkyl radicals are given.—The determination of available plant food in soil by the use of weak acid solvents: A. D. **Hall** and A. **Amos**. The authors have investigated the effect of repeating the attack of weak acid solvents on soils of known history derived from the Rothamsted experimental plots. In the case of soils continuously manured with superphosphate, the phosphoric acid goes into solution at a rate which decreases logarithmically, but soils which have received complex manures do not show the same regular decrement in the amounts of phosphoric acid passing into solution.—The action of ammonia and amines on diazo-benzene picrate: O. **Silberrad** and G. **Rotter**.—The preparation of bistriazobenzene: O. **Silberrad** and B. J. **Smart**.—Gradual decomposition of ethyl diazoacetate: O. **Silberrad** and C. S. **Roy**.—Studies on nitrogen iodide, iii., the action of methyl and benzyl iodides: O. **Silberrad** and B. J. **Smart**.—Action of bromine on benzeneazo-*o*-nitrophenol: J. T. **Hewitt** and N. **Walker**.—The condensation of dimethyldihydroresorcin and of chloroketodimethyltetrahydrobenzene with primary amines, part i., monamines, ammonia, aniline, and *p*-toluidine: P. **Haas**.—Silicon researches, part x., silicon thiocyanate: J. E. **Reynolds**. The author found that silicon thiocyanate, $Si(SCN)_4$, is best prepared by prolonged digestion of excess of pure lead thiocyanate in a benzene solution of silicon tetrachloride.—Halogen derivatives of substituted oxamides: F. D. **Chattaway** and W. H. **Lewis**. A number of substances obtained by the action of halogens on substituted oxamides are described.—Menthyl benzene-sulphonate and menthyl naphthalene-β-sulphonate: T. S. **Patterson** and J. **Frew**.—Some reactions and new compounds of fluorine: E. B. R. **Prideaux**. The fluorine prepared by the electrolysis of anhydrous hydrogen fluoride, contained in a copper vessel, was found to contain oxygen produced at the anode even after the current had passed for a considerable time. Liquid fluorine has no solvent or chemical action on iodine or solid bromine. Bromine fluoride, BrF_3, was prepared for the first time. Gaseous fluorides of selenium, SeF_6, and tellurium, TeF_6, were prepared by direct combination. The vapour pressure curve of SF_6 was compared with those of SeF_6 and TeF_6, and shown to be similar.—Contributions to the chemistry of the rare earths, part i.: M. **Esposito**. The various methods advocated by Watts, Brauner, Popps, Mosander, Debray and others for the separation of cerium, lanthanum, and "old didymium" have been examined comparatively.—A synthesis of aldehydes by Grignard's reaction: G. W. **Monier-Williams**.—The action of ultraviolet light on moist and dry carbon dioxide: S. **Chadwick**, J. E. **Ramsbottom**, and D. L. **Chapman**.—A contribution to the study of stable diazo-compounds, preliminary note: G. T. **Morgan** and W. O. **Wootton**.—Triarylsulphonium bases: S. **Smiles** and R. **Le Rossignol**.—An improved apparatus for the continuous extraction of liquids with ether: R. S. **Bowman**. In this apparatus, which comprises a simple system of tubes, a condenser, and two ordinary flasks, the extraction is effected by passing cool liquid ether through the solution.

Physical Society, January 26.—Prof. J. H. Poynting, F.R.S., president, in the chair.—The isothermal distillation of nitrogen and oxygen and of argon and oxygen: J. K. **Inglis**. Mixtures of liquid nitrogen and oxygen are particularly suitable for an exact study of the relations obtaining during isothermal distillation, for the distillation bulb being the coldest instead of the hottest part of the apparatus, errors due to back condensation, &c., can be eliminated. In addition, the vapour can easily be circulated and passed time after time through the liquid until equilibrium is complete. Experiments were carried out in this way in a specially designed apparatus, and the results showed that the ratio of nitrogen to oxygen in the vapour was not in a constant proportion to the same ratio in the liquid. When, however, the partial pressures of nitrogen and oxygen were plotted against the *concentrations* in the liquid a straight line was obtained in the case of nitrogen and a curve in the case of oxygen. This indicated that nitrogen obeyed Henry's law of solubility, and the deviation in the case of oxygen pointed to its being slightly associated in the liquid state when mixed with nitrogen. A few experiments were also carried out with mixtures of argon and oxygen. At the temperature used, argon was a volatile solid, and therefore the greatest concentration of argon that could be obtained was that of the saturated solution in oxygen. Argon seemed to agree with nitrogen in obeying Henry's law.—The use of chilled cast iron for permanent magnets: A. **Campbell**. The present investigation was made on rings in addition to rods of the standard dimensions usual in testing magnet-steels. All

the specimens were heated to 1000° C. and then chilled in cold water, care being taken to support them during the process, as cast-iron is very brittle at such a high temperature. The rods were tested for maximum remanent B and coërcivity by Madame Curie's method, the magnetised bar being placed in a long solenoid producing a demagnetising field which was gradually increased until a search-coil slipped along the bar showed that the demagnetisation was complete. The results showed the chilled cast-iron to be not very inferior to ordinary magnet-steel. By ballistic tests on the two rings, their permeability curves were obtained, and these indicated that the simple process of chilling used was quite satisfactory even for a tolerably massive ring of 6 sq. cm. cross section. The cheapness and ease of working cast-iron should encourage instrument makers to test its capabilities in various instruments.—Experiments on the propagation of longitudinal waves of magnetic flux along iron wires and rods: Prof. **Lyle** and Mr. **Baldwin.** The experiments described in the paper were undertaken with the object of determining if there is a definite rate of propagation of magnetism in iron. The method adopted was to produce magnetisation at a particular point on a bar by means of a coil through which an alternating current was passed, and then to observe the magnetic flux at various distances from the coil by means of a small secondary coil, free to be moved to various places on the bar. By the use of Prof. Lyle's wave-tracer the magnetic flux at various points along the bar was thus obtainable. The wave curve was then analysed by Fourier's series. Various curves given in the paper show the value of the constants in Fourier's series and of the lag in the magnetisation as the coil was moved along the bar. Contrary to what had been observed in previous researches, the authors found that the phase lag, instead of continuously increasing along the bar, reached a maximum value and then diminished, proving the absence of true wave propagation.

Mineralogical Society, January 23.—Prof. H. A. Miers, F.R.S., president, in the chair.—Studies in crystallisation; sodium nitrate: H. A. **Miers** and J. **Chevalier.** Microscopic observations were made upon solutions of known strength contained in open tubes or sealed tubes maintained at a known temperature, or in the form of drops upon a slide, with the object of comparing the growth of crystals in metastable and labile solutions respectively. The limits of the labile state (in which the solution can crystallise spontaneously) have been fixed by previous experiments by H. A. Miers and Miss F. Isaac. If a crystal of the salt be introduced into a supersaturated solution which is not labile, the centres of growth of new crystals are on its surface, and they grow in parallel positions upon it; if it be introduced into a labile solution the new centres of growth are in its neighbourhood, and the crystals fall upon it in various positions. If it be moved about in either, a cloud of crystals is produced; but in the metastable solution this appears to be due to minute crystals which are swept from its surface. A crystal having appeared spontaneously can continue to grow in a labile solution without producing others in its neighbourhood, but if introduced it at once produces a cloud. This may be because the growing crystal is surrounded by a zone of metastable solution.—Geikielite and the ferro-magnesian titanates: T. **Crook** and B. M. **Jones.** Geikielite occurs in association with magnesian menaccanite and common ilmenite (menaccanite) in the gem gravels of the Balangoda and Rakwana districts of Ceylon. A considerable number of analyses indicate that geikielite varies in composition, the iron oxides ranging from 8 per cent. to 14 per cent. No specimen has hitherto been found which contains less than 8·1 per cent. of iron oxide. For this reason the formula $(Mg,Fe)TiO_3$ is preferable to $MgTiO_3$ as expressing the true composition of geikielite. Magnesian menaccanite containing about 28 per cent. of iron oxide is very closely allied to geikielite in all its properties, more so than to common ilmenite. The alteration products of geikielite are similar to those of ilmenite, consisting of rutile and so-called leucoxene; the latter is a mixture of amorphous titanic acid, sphene, and limonite. It seems advisable to classify the ferro-magnesian titanates as ilmenites and geikielites, treating magnesian menaccanite (which has the formula $(Fe,Mg)TiO_3$, where $Fe : Mg = 1 : 1$) as the middle member of the series.—G. F. Herbert **Smith** exhibited, and explained the use of, a diagram for the graphical determination of the refractive index from the prism angle and the angle of minimum deviation. He also explained a simple test for ascertaining the pair of faces corresponding to any refracted image.

Dublin.

Royal Dublin Society, December 19, 1905.—Dr. R. F. Scharff in the chair.—The causes of "blowing" in tins of condensed milk: Dr. G. H. **Pethybridge.** Blowing (*i.e.* bulging) is caused by the accumulation of gas produced by the fermentation of the cane sugar added during manufacture by certain wild yeasts or torulæ, which can ferment saturated solutions of sugar, and appear to be present in the original milk supplies, and are not introduced during the process of manufacture.—Two new species of Collembola for Ireland: Prof. G. H. **Carpenter.** The species described belong to the genera Isotoma and Entomobrya, the latter showing some interesting special affinities with Orchesella.

Edinburgh.

Royal Society, January 8.—Prof. Crum Brown, vice-president, in the chair.—*Bathydraco Scotiae*, Poisson abyssal nouveau recueilli par l'Expedition Antarctique national Écossaise. Note préliminaire: Louis **Dollo.** The genus Bathydraco was instituted by Günther in 1878 for a small fish (*B. antarcticus*, Günth.) from the south east of Heard Island, inhabiting a depth of 1260 fathoms. The new species, named by M. Dollo, was obtained in the Weddell Sea at a depth of 1410 fathoms.—Influence of thymus feeding on allantoin excretion: Dr. J. **Maclachlan.** The work was based on experiments carried out in the laboratory of the Royal College of Physicians of Edinburgh. Reference was made to the very unsatisfactory nature of the evidence on the influence of uric acid and nucleins on the production of allantoin, and it was pointed out that the administration of thymus substance was invariably followed by a large production of allantoin. The point investigated was whether this was due to the conversion of the nucleins and puric bodies contained in the thymus or to some specific action of the substance. Boiling the thymus before it was administered reduced its power of producing allantoin to less than half. Thymus also was found to exercise a much more marked effect in causing the production of allantoin than other glands, such as pancreas, liver, and lymphatic glands, which are also rich in nucleins. The conclusion drawn was that raw thymus when administered produced a specific action on the metabolism by which the formation of allantoin was increased.—A theorem in hyper-complex numbers: J. H. Maclagan **Wedderburn.** A short proof was given of a theorem, first proved by Scheffers, that an algebra which contains the quaternion algebra can, if the moduli of the two algebras are the same, be expressed as the product of the quaternion algebra and another algebra. The theorem was then extended to a large and important class of algebras.

January 22.—Lord M'Laren, vice-president, in the chair.—A form of initiational disturbance more convenient than that of §§ 3–31 of previous papers on waves: Lord **Kelvin.** The investigations of §§ 5–31, including the "front and rear" of infinitely long free processions of waves in deep water, are all founded on superposition of equidistant initiational disturbances, the first of two typical forms described in §§ 3, 4. In this form the initial disturbance is everywhere elevation or everywhere depression, and its amount at great distances from the middle varies inversely as the square root of the distance from a horizontal line at a small height above the water surface in the middle of the disturbance. A type-disturbance derived mathematically from that used in §§ 5–31 by double differentiation with reference to time, or by single differentiation of the second of the forms of §§ 3, 4 with reference to space, is given in the present paper, and illustrated by diagrams of curves placed before the society, in which the initial disturbance has as much water above as below the undisturbed level; and at great distances the depression or elevation varies inversely as the 3/2 power

of the distance. This derived solution is used in the two following papers, for which it is found much more convenient than the solution used in §§ 5–31.—Illustrations of the indefinite extension and multiplication of a group of two-dimensional deep-sea waves, initially finite: Lord **Kelvin.** The water is left at rest and free, after being artificially displaced to a configuration of a finite number of sinusoidal mountains and valleys—five mountains and four valleys in the initiation of the diagrams placed before the society. Immediately after the water is left free, the disturbance begins analysing itself into two groups of waves, seen travelling in contrary directions from the middle line of the diagram. The perceptible fronts of these two groups extend rightwards and leftwards from the end of the initial single static group, far beyond the "hypothetical fronts" supposed to travel at half the wave velocity, which (according to the dynamics of Osborne Reynolds and Rayleigh in their important and interesting consideration of the work required to feed a uniform procession of water-waves) would be the actual fronts if the free groups remained uniform. How far this is from being the truth is illustrated by the diagrams. Besides the great extension of the fronts outward from the middle, we see that the two groups, after emergence from perceptible co-existence in the middle, travel with their rears leaving a widening space between them of water not perceptibly disturbed, and with wavelets in ever augmenting number following slower and slower in the rear of each group and causing the extreme perceptible rear to travel at a much smaller speed than half the "wave velocity." It is obviously difficult to give any definition of an "effective front," or of a "centre of group," or of a "virtual rear," according to which we could regard the group as travelling with half the wave velocity or *with any single definite velocity*.—The initiation and continued growth of a train of two-dimensional waves due to the sudden commencement of a stationary periodically varying forcive: Lord **Kelvin.** A forcive consisting of a finite sinusoidally varying pressure is applied, and kept through all time applied, to the surface of the water within a finite practically limited space on each side of the middle line of the disturbance. In the beginning the water was everywhere at rest and its surface horizontal. The problem to be solved is, to find the elevation or depression of the water at any distance from the mid-line of the working forcive, and at any time after the forcive began to act. The solution was illustrated by two diagrams—time curves—one showing the motion of the water at the mid-line of the working forcive, the other showing the motion at a distance from this line equal to the wave-length that would be in an endless uniform procession of waves having period equal to the period of the disturbing forcive. Calculations are in progress to give the motion of the water at eight wave-lengths from the source. The detailed calculations were made and the curves drawn for Lord Kelvin by Mr. George Green.

Erratum.—In the report of the meeting of November 20, 1905 (NATURE, December 28, 1905), the words "quite did away with" on p. 216, line 23, should be "had no appreciable effect on."

PARIS.

Academy of Sciences, January 29.—M. H. Poincaré in the chair.—New researches on the insoluble alkaline compounds contained in living plants: M. **Berthelot.**—The capture of a whale (genus Kogia) near Roscoff, English Channel: Yves **Delage.** The animal was captured at Siec, about 6 kilometres from Roscoff. The species is extremely rare, and has never been previously observed in European waters.—Certain systems of circles and spheres which occur in the deformation of quadrics: C. **Guichard.**—The perpetual secretary announced the death of Sir John Burdon-Sanderson, correspondant for the section of medicine and surgery.—Differential equations of the second order of which the general integral is uniform: M. **Gambier.**—The flame spectrum of mercury: C. **de Watteville.** Attempts to photograph a flame spectrum of mercury have been hitherto unsuccessful. By the use of solutions of the acetate and cyanide of mercury, sprayed into a flame, the author has been successful in obtaining the flame spectrum of mercury, consisting of the single line 2536·72. This line was measured by Kayser and Runge in the arc spectrum of mercury.—The duration of the discharge in an X-ray tube: André **Broca.** With equivalent sparking distances varying from 6 cm. to 10 cm., the time was practically constant, 0·0006 sec.—The diminution of the radio-activity of polonium with time: Mme. **Curie.** The intensity of the radiation diminishes with the time according to a simple exponential law, $I = I_0 e^{-at}$. If t is expressed in days, $a = 0{\cdot}00495$, or the intensity falls to half its value in 140 days. A diagram is given showing the linear relation between log I and the time, the deviations between the values obtained from the above law and from experiment not exceeding 3 per cent. The agreement of the constant (0·00495) with that found by Marckwald for radiotellurium (0·00497) shows that the latter substance is identical with polonium.—The sulphates of some rare metals: Camille **Matignon.** Thermochemical measurements on the sulphates of lanthanum, praseodymium, neodymium, and samarium.—The rapid preparation of solutions of hydriodic acid: F. **Bodroux.** A given weight of iodine is divided into two equal portions. By the interaction of barium peroxide and the first portion, barium iodide is produced; the remainder of the iodine is dissolved in the solution of barium iodide, and the liquid treated with sulphur dioxide until decolorised, filtered from the barium sulphate, and redistilled.—An alloy of thorium and aluminium: O. **Hönigschmid.** This alloy, the composition of which corresponds to the formula $ThAl_3$, can be obtained in the form of long hexagonal prismatic needles possessing the colour and metallic lustre of aluminium, by the reduction of thorium oxide by aluminium in the electric furnace. It can also be obtained by the interaction of aluminium and the double fluoride of aluminium and thorium at a high temperature.—Researches on the halogen compounds of the borates of barium and strontium: L. **Ouvrard.** The borates of barium and strontium appear to enter into combination with chlorine and bromine less easily than the corresponding salts of calcium, only one halogen compound of each being obtainable.—α- and β-campholytic alcohols: G. **Blanc.** Details of preparation and physical properties. The pyruvic ester of each is described, and the corresponding semicarbazones.—The influence of the reaction of the medium upon the activity of the diastases: A. **Fernbach.** Remarks on a recent note on the same subject by L. Maquenne and E. Roux.—The nutrition of green plants by amides in the absence of carbon dioxide: Jules **Lefèvre.** Experiments made on the dwarf nasturtium led to the following conclusions:—Plants deprived of carbon dioxide and amides lose a notable proportion of their initial weight, this loss being due to respiration. Plants kept in the light, with amides present in the soil, in spite of the absence of carbon dioxide, developed and increased their dry weight. Light is essential for the utilisation of the amides by the plant.—A new parasitic fungus, *Trematovalsa Matruchoti*, causing the disease of the silver lime tree: Nicolas **Jacobesco.** This fungus is the cause of a disease which has ravaged the lime forests of Wallachia. It appears to belong to a new family.—The classification into genera of the family of the Bradypodidæ (genus Hemibradypus): R. **Anthony.**—Contribution to the general morphology of the higher Protozoa: J. **Kunstler** and Ch. **Gineste.**—The anatomy and histology of the Ixodidæ: A. **Bonnet.**—The effect of the injection of extract of the interstitial gland of the testicle on the growth: P. **Ancel** and P. **Bouin.**—Tables of growth drawn up in 1905 from the measurements of 4400 Parisian children between the ages of one and fifteen years: MM. **Variot** and **Chaumet.** The results are given both in graphical and tabular form, comparison being made with similar measurements of Bowditch (Massachusetts) and Rotch (Boston).—The physiological conditions of oral teaching: Pierre **Bonnier.** The effects of a want of knowledge of the principles of voice production are throat troubles with the teachers and increased mental effort on the part of the pupils. Measurements are given showing the importance of the latter effect.—Chloroform anæsthesia. The estimation of the chloroform before, during, and after anæsthesia is set up, and the quantity in the blood at the moment of death: Maurice **Nicloux.**—The Neocretacean ammonites collected by the Swedish Antarctic Expedition: W. **Kilian.**—The geology of the Peloponnesus: Ph. **Négris.**

GOTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts iv. and v. for 1905, contains the following memoirs communicated to the society :—

July 8.—Determination of all curves by the translation of which minimal surfaces are generated : P. **Stäckel.**

July 22.—Outlines of a general theory of linear integral equations, x., Riemann's problems in the theory of functions of a complex variable : D. **Hilbert.**—On finite algebras : L. E. **Dickson.**—On pyroelectricity in centro-symmetric crystals ; with appendix (October 28) : On the piezoelectricity of centric crystals : W. **Voigt.**

August 5.—On the origin of the salt deposits of north-west Germany : A. **von Koenen.**

November 25.—Remarks on an essay on the stellate appearance of the stars (*Nachrichten*, 1905, p. 238). The effect of the background on the estimation of magnitude (*e.g.* of the moon on the horizon). The "jumping" of the image in vision with the right and the left eye alternately : W. **Holtz.**—Measurements of the density of the vertical electric conduction-current in free air made during the balloon voyage of August 30, 1905 : H. **Gerdien.**—The Doppler effect in "Canal-strahlen" and the spectra of positive atomic ions : J. **Stark.**—Determination of all curves by the translation of which minimal surfaces are generated : G. **Scheffers.**

The official communications, part ii., for 1905, of the *Nachrichten* contain an anniversary address by W. **Voigt** on hypotheses concerning work.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—On Roche's Ellipsoids and on Allied Problems Relating to Satellites : Sir George H. Darwin, K.C.B., F.R.S.—Polarisation in Secondary Röntgen Radiation : Dr. C. G. Barkla.—Ionic Size in Relation to the Physical Properties of Aqueous Solutions : W. R. Bousfield, K.C.—Explosions of Coal-Gas and Air : Prof. B. Hopkinson.—On Periodicities in Sun spots : Prof. A. Schuster, F.R.S.—Constants of Explosion of Cordite and of Modified Cordite : Dr. Robert Robertson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Technical Considerations in Electric Railway Engineering : F. W. Carter (*Conclusion of Discussion*).—Crane Motors and Controllers : C. W. Hill

ROYAL INSTITUTION, at 5.—The Significance of the Future in the Theory of Evolution : Benjamin Kidd.

MATHEMATICAL SOCIETY, at 5.30.—Special General Meeting.—Partitions of Numbers in Space of two Dimensions : Major P. A. MacMahon.—The Eisenstein-Sylvester extension of Fermat's Theorem : Dr. H. F. Baker.

FRIDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Eclipse Problems and Observations : H. F. Newall, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting. Address by the President-elect, Prof. J. Perry, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 5 30 (Research Department).—The Ruins of Rhodesia and the Probable Date of Outside Intrusions in East Africa : Discussion to be opened by D. Randall MacIver.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—On Pearl-Oyster Culture and Pearl Fishing : T. H. Haynes.—Irish Molluscs and their Habitats : R. J. Welch.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Electric Driving at the Locomotive Works of the North London Railway : R. H. Mackie.

SATURDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 3.—Advances in Microscopy ; J. W. Gordon.

MONDAY, FEBRUARY 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geography of the Spanish Armada : Rev. W. Spotswood Green.

SOCIETY OF ARTS, at 8.—Modern Warships : Sir William White, K.C.B., F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Graduates' Lecture : The Niagara Power-Stations : Prof. W. C. Unwin, F.R.S.

TUESDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 5.—Food and Nutrition : Prof. W. Stirling.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Lantern-slides of Kikuyu Ceremonies : W. Scoresby Routledge.—Exhibition of Kikuyu Ceremonial Images : T. A. Joyce.—Exhibition of Slides of Rude Stone Monuments and Notes on Stone Monuments in Glamorganshire : A. L. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion* : The Railway-Gauges of India : F. R. Upcott.—*Probable Papers* : Country Roads for Modern Traffic : J. E. Blackwall.—A Plea for Better Country Roads : G. R. Jebb.

WEDNESDAY, FEBRUARY 14.

SOCIETY OF ARTS, at 8.—The Horseless Carriage, 1885–1905 : Claude Johnson.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers* : The Influence of Increased Barometric Pressure on Man, No. 1 : Dr. L. Hill, F.R.S., and M. Greenwood.—On the Existence of Cell-communications between Blastomeres : C. Shearer.—Innervation of Antagonistic Muscles. Ninth Note : Successive Spinal Induction : Prof. C. S. Sherrington, F.R.S.—The Chemical Constitution of Protoplasm as shown by the Rate of Tissue Disintegration : Dr. H. M. Vernon.—The Development of the Head-Muscles of the Common Fowl (*Gallus domesticus*), together with some Remarks on the Head-Muscles of Reptiles : Prof. F. H. Edgeworth.

CHEMICAL SOCIETY, at 8.30.—Cuprous Formate : A. Angel.—The Solubility of Triphenylmethane in Organic Liquids with which it forms Crystalline Compounds : H. Hartley and N. G. Thomas.—The Spontaneous Crystallisation of Supersaturated Solutions : H. Hartley.—The Preparation and Properties of some New Tropeines : H. A. D Jowett and A. C. O. Hann.—Studies in Asymmetric Synthesis, Part IV., The Application of Grignard's Reaction for Asymmetric Syntheses : A. McKenzie.

LINNEAN SOCIETY, at 8.—The Structure of *Isis hippuris* : J. J. Simpson.—Note on the Geographical Distribution of the Genus Shortia, Torr. and Gray : B. Daydon Jackson.—*Exhibition* : Developmental Changes in Zooglœa (with Lantern Slides) : Dr H. Charlton Bastian, F.R.S.

SOCIETY OF ARTS at 4.30.—The Navigable Waterways of India : R. B. Buckley, C.S.I.

INSTITUTION OF MINING AND METALLURGY, at 8.—Pyritic Smelting : R. C. Alabaster and F. H. Wintle.—The Acme Combined Concentrating Table : L. H. L. Huddart —Stadia in Careful Work : A. H. Webb.—The Detailed Mapping of Stoping Areas : H. R. Sleeman —Sinking, Development and Underground Equipment of Deep Level Shafts on the Rand : A. E. Pettit.—The Hydraulic Filling of a Coal Seam at Lens, Pas de Calais, France : L. E. Hill and M. Butt.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 9.—The Passage of Electricity through Liquids : W. C. D. Whetham, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Large Locomotive Boilers : G. J. Churchward.

SATURDAY, FEBRUARY 17.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTES (Regent Street Polytechnic), at 7.30.—The Teaching of Mathematics to Engineering Students : G. E. St. L. Carson.—The Teaching of Mathematics to Building Trade Students : H. Bustridge.

CONTENTS.

THURSDAY, FEBRUARY 15, 1906.

BIOLOGICAL HERESIES.

The Nature and Origin of Living Matter. By Dr. H. Charlton Bastian, F.R.S. Pp. 344; with 245 illustrations from photomicrographs. (London: T. Fisher Unwin, 1905.) Price 12*s.* 6*d.* net.

DR. H. CHARLTON BASTIAN re-expounds his well known biological heresies with a vigour and industry worthy of a better cause. The first heresy is that "*archebiosis*" is a present occurrence, that is, that living organisms may here and now arise from non-living materials. What seems to most biologists so difficult to conceive with any concreteness, that their evolutionist faith is strained a little to believe it may have occurred *once* long ago, may be seen occurring any day in this veteran experimenter's laboratory. What Pasteur looked out for in vain for a score of years has been revealed to Bastian's persistent patience. The second heresy is that "*heterogenesis*" is not infrequent, that is, that a living creature may give rise to alien offspring, to organisms quite different from itself, it may be belonging to a different class altogether. Against the fact of the persistence or continuity of hereditary resemblance we are accustomed to balance the fact of variation; but now we are asked to make room for what is more than the most convinced believer in mutations or transilience ever dreamed of, namely, such facts of heterogenesis as the production of infusorians from a rotifer's egg. Our convictions as to the specific plasmic architecture of different forms of life, our difficulty in imagining how chlorophyll corpuscles can become a swarm of sun-animalcules, must be corrected, like other prejudices, by facing the facts. To ignore these is the worst form of *ignorantia elenchi* of which scientific students can be guilty. If nature's method includes the hop, step, and leap phenomena, which this book describes at great length, what can excuse the blindness of those who persist that evolution is like a snail's continuous crawl?

To see what Dr. Bastian interprets as archebiosis, we are recommended to take an infusion of turnip or fresh beef, to filter this through two layers of the finest Swedish paper, to let a drop fall on a cleaned microscope slip, to put a cover-glass on, to remove excess of fluid with blotting-paper, to allow one or more air-bubbles to remain in the film, to seal up with melted paraffin wax, to fix upon a clear space free from particles near an air-bubble, to incubate at blood-heat for two or three hours, and to await events. The expected happens—multitudes of living particles appear. How can we account for their origin? Three hypotheses present themselves, (*a*) that they have arisen through the reproductive multiplication of one or more germs that had escaped observation in the film; (*b*) that they have developed from a multitude of diffusely disseminated *invisible* germs; or (*c*) that they have been produced *de novo* in the fluid by a process of archebiosis. The author argues that the third interpretation is the true one. One of the arguments is based on the uniformity of nature:—

"To assume, as the great majority of Evolutionists do, that Archebiosis, or the natural origin of living matter, took place once only in the remote past and that it has not been repeated, or if repeated in past times, that it no longer goes on, is to look upon this process as a kind of natural miracle, and to postulate a break in continuity which ought only to be possible in the face of overwhelming evidence of its reality. This latter is, however, as I contend, altogether absent to anything like an adequate extent."

This kind of argument applied to other great events in evolution has the advantage of fostering an expectant attitude. Nature may be repeating herself oftener than we think.

Many of us have made flask experiments with super-heated organic fluids, which remained sterile for years without any hint of archebiosis; but, of course, these experiments only prove that living organisms do not arise under these severe conditions. We must give archebiosis a chance, and unluckily that chance usually means either an open door to infection or imperfect sterilisation. But the surer work we make with sterilisation, the greater likelihood is there of our destroying what Dr. Bastian calls the *germinality of the fluids.* When organisms do *not* appear in the sterilised medium the sceptical experimenter says "Biogenesis is confirmed," whereas he ought to say "Unluckily, I have destroyed the germinality of good archebiotic material." When organisms *do* appear in the sterilised medium the sceptical experimenter says "What an ass I am!" but if he were not so slow of heart to believe, he should say "Archebiosis for ever."

As to the original archebiosis in free nature, the author makes the suggestion that nitrate of ammonia (or nitrite?), which is formed in the atmosphere in thunderstorms and brought down by the thunder shower, may have played an important part in the mixture of ingredients in which protoplasm was first synthesised.

Dr. Bastian's patient experiments on heterogenesis raise, as it seems to us, some interesting questions concerning the variability of minute organisms, the phases in the life-history of many forms which are very inadequately known, the occurrence of "latent germs" in the interior of healthy fruits and animal organs, and so on. But we are too bigoted to believe that diatoms can be produced by the transformation of the cells of an unrelated alga, that anabena or actinophrys or amœbæ can arise from chlorophyll corpuscles, that the eggs of a fly may be transformed into infusorians, or that several different kinds of ciliata may arise from the eggs of one and the same rotifer. While all this is incredible to us because it is magical and unmeaning—incongruous with our experience of nature's workings—the difficulty is to interpret what Dr. Bastian saw and photographed. We venture the suggestion that in some of the egg-experiments he may have been on the track of ovivorous parasites such as are known to infest the eggs of some aquatic insects.

R

While we must stand aloof from Dr. Bastian's heresies, we cannot but admire his dogged support of what seems to us a lost cause. It is something to stand *unus contra mundum* with no loss of courage or of good humour. We also sympathise with some of the positions which the author maintains in the introductory part of his book, *e.g.* as to the innate or intrinsic variability of living matter, and as to the importance of discontinuous variations or mutations. There is also much vigorous criticism of Weismann's last volume, "The Evolution Theory," and a defence of Spencer's concept of "physiological units" as against Weismann's "determinants." But when, in regard to the transmission of modifications, Dr. Bastian says that "Weismann frankly admits the whole point in dispute—namely, that *acquired characters can be, and are, frequently inherited*," we must express our surprise at what seems to us an extraordinary misunderstanding. J. A. T.

A STANDARD TREATISE ON PHYSICS.

Lehrbuch der Physik. By O. D. Chwolson. Vol. iii. Translated into German by E. Berg. Pp. xi+988; illustrated. (Brunswick: Vieweg und Sohn, 1905.) Price 16 marks.

Traité de Physique. By O. D. Chwolson. Translated from the Russian and German editions into French by E. Davaux, with Notes on Theoretical Physics by MM. E. and F. Cosserat. Vol. i., part i., pp. xiii+407; vol. ii., part i., pp. vii+202. (Paris: A Hermann, 1906.) Price 16 francs and 6 francs respectively.

THE first two volumes of this important translation from Russian into German have already been noticed in these columns. The present volume embraces the science of heat, including thermodynamics. The treatment throughout is most admirable both for accuracy and lucidity, and the treatise may be expected to become generally known in this more accessible shape. Each chapter is followed by copious references to original sources of information; these are divided into sections numbered according to the parts of the text to which they relate; they constitute a valuable summary of the most important memoirs, especially as they include quite recent work as well as the earlier work which formed the foundation of the science of heat. The illustrations are excellently done.

Besides the phenomena which are usually described in a treatise on physics (thermometry, expansion, thermal capacity, laws of cooling, conductivity, general thermodynamics, and equations of state), chapters are to be found here on thermochemical investigations and the theory of solutions, including the phase rule. These are not in any way skimped. An outline of everything that is worth knowing seems to be included. The matter is not served up in a haphazard manner; but the relative value of different investigations is well brought out by the amounts of space which are devoted to them. The book is a happy mixture of theory and practice. For example, while a delightfully clear explanation is given of the meaning of the various partial differential coefficients which arise in theoretical thermodynamics, there is also given one of the very few existing correct accounts of the implication of the Joule-Thomson experiment.

The methods of Planck are followed in connection with thermodynamics. The play of entropy in irreversible transformations is made very clear; a student, by its perusal, could hardly fail to get nearer to a true conception of the nature of such processes.

The results of an investigation are not merely summed up in a formula; in most cases a table of experimental data upon which the formula is based is also provided. This, of course, is as it should be. for it puts the reader at once in touch with the actual experiment, and differentiates the volume from a mere collection of physical tables.

Altogether, we do not hesitate to say that the three volumes form as satisfactory a treatise on the part of physics to which they relate as we have ever met with. They are to be followed by a fourth volume on electricity and magnetism.

In the translation into French both the Russian and German editions are made use of, while additional notes on theoretical physics are added by MM. E. and F. Cosserat, the former of whom is a professor in the University of Toulouse. This also will appear in four volumes; the present instalment consists of parts of the first two. The additional notes will be kept quite distinct from the main text. One such note (consisting of 37 pages) now appears on the dynamics of a particle and of a rigid body. This is an attempt to re-state the principles of mechanics in such a way as to remove the difficulties pointed out by M. Poincaré in the application of mechanical principles to natural phenomena. These difficulties arise, according to Poincaré, from a too faithful application to all phenomena of the theory of the astronomical universe. The system of mechanics expounded is in general based on energetics, but a wider form than usual is given to this principle. It is impossible to criticise the theory presented until the remaining notes bearing on it have appeared.

With regard to the French edition in general we are very well pleased, and we look forward to its completion, for there are many to whom it will prove more welcome than its German equivalent. The treatise bids fair to prove itself the leading text-book of physics for general use.

CLIMBS IN WESTERN CANADA.

In the Heart of the Canadian Rockies. By James Outram. Pp. 466; with maps and 46 illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1905.) Price 12*s.* 6*d.* net.

IN the "Apology" with which this volume is prefaced, the author tells how he went to the mountains during a part of three summers to recuperate from mental overstrain, and states that he has been hampered by the same disability in preparing his book. Nevertheless, he has succeeded in producing a useful piece of work, which brings together an account of all that has been accomplished in the

Canadian Rockies by himself and by other kindred spirits.

Though essentially and avowedly a mountain-climber's book, it incidentally places before the reader much information regarding the physical geography of an imperfectly known region that is full of interest. The author's sympathy in the natural beauty of this magnificent country is expressed simply and moderately, and his descriptions therefore, though not particularly vivid, ring true. The aim and effort of his toilsome journeyings was ever to reach the mountain-tops—preferably the tops hitherto untrodden—and all other considerations were subordinate to this desire. How difficult often was the attainment, and yet how great was his success, is faithfully chronicled in these pages. Along the main chain of the Rockies—those huge stratified wedges left by Nature's Quarriers to show how much has been excavated from Mount Columbia (12,500 feet) in the north to Mount Lefroy (11,290 feet) in the south, and also on the crests of the Ottertail Range outstanding to the west—Mr. Outram and his Swiss guides have scored their innocent conquests and have brought back increased knowledge of forests, glaciers, snow-fields, and craggy peaks.

By conveniently interweaving in his narrative full extracts from the records of other explorers, the author enables us to recognise the salient features of this wilderness of mountains, and in so doing to increase our sense of enjoyment in them. For, as the author has noted, it is curious how, when confronted by some wide and novel prospect, we instinctively search for some feature already known, upon which our new perceptions may form themselves; and great is the relief to our confused senses as soon as a recognisable point is found. In mountain scenery, lack of familiarity usually implies also lack of that knowledge of distances and heights which is an essential ingredient to the full impressiveness of the prospect: for it is not the low-angled picture in the eye, but the interpretation of it, that stirs emotion. The ancients did not know their mountains well enough to appreciate them.

For the same reason it is essential that mountains should have names; but it seems deplorable that almost all the peaks of the Canadian Rockies should have had meaningless personal names attached to them. Better the most tongue-twisting native term or the most bizarre appellation of the backwoodsman! Yet it must be admitted that we agree with the author in desiring something less cumbrous than "The West Branch of the North Fork of the North Saskatchewan" as the name for a stream!

The book is well illustrated by reproductions from photographs of many of the mountains and other striking features in the scenery of the region. But photographs of this kind, and still more the process-illustrations prepared from them, yield only a feeble image, useful perhaps as a reminiscence to anyone who has experienced the scene, but always unsatisfying.

By an evident oversight, no scale is attached to the two maps interleaved in the text, though these are not on the same scale as the folder at the end of the volume. And is it by accident or design that the seven-line quotation of Sir Edwin Arnold's verse which is given at the beginning of the first chapter of the book is repeated, with a slight variation, at the end of the last chapter?

G. W. L.

SCIENCE AND ART OF CARPENTRY.

A Manual of Carpentry and Joinery. By J. W. Riley. Pp. viii + 500. (London: Macmillan and Co., Ltd., 1905.) Price 6s. net.

THIS is a handy little volume on a well-worn subject, about which there are many works extant, but it contains a good deal of useful information for the student in one of the noblest of the crafts. It was Lord Avebury who compared wood to metal, and dwelt on the higher qualities of the former material as a field for the perpetuation of the more enduring forms of art.

The present manual, besides dealing with the various operations of the carpenter, starts with the consideration of geometry, mensuration, and mechanics as a necessary preliminary for his education if he would work with benefit to himself and his employers. The qualities of various kinds of timber, its structure and growth, method of conversion, defects, and preservation are explained. Chapters on plane and solid geometry and mensuration in relation to carpentry follow, and these are probably the best chapters in the book, because of their importance to the student in their relation to the craft.

The chapter on tools is well illustrated—saws, planes, chisels, gouges and centre bits being shown. The inclusion of wood-working machinery is an innovation which will be welcomed because of the increasing importance of machinery in these days. This chapter is also well illustrated with woodcuts of sufficiently large size to render them useful and explanatory. In fact, although some might say that machines are hardly a part of a student's education, we think the author is right in including them, and it certainly is a novel feature in a text-book for elementary students. Joints and fastenings in floors, roofs and beams, dovetails of various forms used in joinery, and keying and clamping are then described.

The various kinds of wooden floors, the method of "trimming" round fireplaces, and the joints of different kinds between floor boards are also dealt with. We should like to have seen a condemnation of the usual system of constructing floors with a hollow space between floor boards and plaster ceiling, forming a series of continuous dustbins for the collection of filth of all kinds. Many architects frequently omit the plaster ceiling altogether.

The usual types of wooden roofs and trusses and the method of finding bevels for rafters at different inclinations, the different kinds of partitions, scaffolding, jib cranes, shoring of buildings, are all parts of the craft which Mr. Riley has carefully explained with illustrations. The chapter on the mechanics of carpentry and the theory of the parallelogram of

forces, the use of a polar diagram and its application to weighted beams are clearly set out.

Door and panelled framing, revolving vestibule doors, hinges and locks, and the different varieties of windows, sash or casement are explained and illustrated. We cannot understand why writers on the subject are always content to show window frames "in reveal" when they appear to so much better advantage only slightly set back from the face of the wall, as in "Queen Anne" and "Georgian" architecture, and as carried out by so many of the best architects of to-day.

There are also chapters on roof lights and conservatories, staircase work and handrailing, and workshop practice, together with summaries and questions from papers set at the City and Guilds examinations in the subject.

OUR BOOK SHELF.

Die Explosivstoffe mit besonderer Berucksichtigung der neuren Patente die Schiessbaumwolle (Nitrocellulosen). By Dr. Richard Escales. Pp. viii+308. (Leipzig: Veit and Co.) Price 10 marks.

THIS is the second volume of a series of special works on explosives. Although the first volume on "Gunpowder and Similar Mixtures" was issued as recently as 1904, it has been found necessary to prepare a new edition, and doubtless the first edition of the volume under consideration will soon be exhausted. The whole series when completed should form a valuable reference work on all subjects relating to explosives.

The book is thoroughly up to date, and reference will hardly be in vain for any information either as to details of manufacture or the more purely scientific questions relating to nitrocellulose or closely allied bodies. The testing of guncottons to determine their stability and the influence of methods of preparation on this have received a great deal of attention during the last three or four years, since it is generally recognised that the older stability tests are often unsatisfactory when taken alone. The author has collected and arranged in excellent form all possible information on this important matter up to quite a recent date.

Special reference is made to new patents, and this information will be of great service to those engaged in the manufacture of this important class of bodies.

J. S. S. B.

Lehrbuch der technischen Physik. By Prof. Hans Lorenz. Zweiter Band, Technische Warmelehre. Pp. ix+544. (Munchen: R. Oldenbourg, 1904.)

THE first volume of this text-book, dealing with the mechanics of solids, appeared some three years ago. It was to have been followed by a volume on hydromechanics, but this has been delayed to include later developments, and its place has been taken by the present volume on heat, which was originally intended to come third in the series. The general scope of the book is similar to that of the first volume. It is not a "technical" handbook as we understand it. There are no descriptions or figures of machines, or even of instruments for measurement. There are no details of experimental methods, nor any mention of precautions necessary for securing accurate results. The whole work is as purely theoretical as any Cambridge mathematical text-book; but the theory is limited to such parts of the subject as have practical applications, with a few numerical tables introduced here and there for the comparison of the equations with experimental results. Such a book might be written by anyone of sufficient mathematical ability without any practical knowledge of the subject, and might be thoroughly assimilated by the student without imparting to him any power of applying the theory to a practical case. One cannot help feeling that, in a subject where so much depends on experiment, and for the technical student who wishes to learn how to apply his knowledge, the utility of the book would be greatly enhanced by a judicious admixture of practice with the theory.

From the purely theoretical standpoint there are many details which are open to criticism. Empirical and theoretical formulæ are in places so interwoven that the student would find it very difficult to disentangle the theory from the consequences of some purely empirical assumption. Though one would certainly hesitate to recommend the book to the technical student wishing to learn how to apply the theory, it might provide him with a useful kind of mental discipline, and prove a good antidote to the more common kind of technical treatise in which experimental results are reduced to a series of purely empirical and often theoretically inconsistent formulæ.

H. L. C.

The Making of East Yorkshire: a Chapter in Local Geography. By T. Sheppard. Pp. x+29; 4 plates. (London: Brown and Son, 1906.) Price 1s.

THE teachers of Yorkshire are blessed by nature with an environment of abounding interest; added to this they have, what is equally to their advantage, a goodly supply of able exponents of nature's beauties, amongst whom the author of this brochure takes a worthy place.

Mr. Sheppard gives a clear account of the geological vicissitudes through which east Yorkshire has passed from Liassic to recent times. He has naturally selected the salient points, but a word or two about the conditions which governed the deposition of some of the argillaceous deposits would have resulted in a better balanced story. The imaginative reader who attempts to visualise the statement at the foot of p. 20 will be presented with an awesome and none too truthful picture—but this is quite a small matter.

Every teacher in east Yorkshire should possess a copy of the pamphlet; and it would be an excellent thing if our other counties could each be supplied with a similar sketch of their geological history.

J. A. H.

Jahrbuch der Chemie. Edited by Richard Meyer. Pp. xii+589. (Brunswick: Vieweg und Sohn, 1905.) Price 16s.

WE have previously had occasion to commend Meyer's "Jahrbuch" to English readers, and the new volume compares favourably with its predecessors.

That lucidity in some of the abstracts is sacrificed to brevity naturally follows from the vast amount of information which is compressed into a limited space; after all, one valuable feature of a year-book is the completeness of its references. It has been previously observed that the "Jahrbuch" has a distinctly German bias, which, perhaps, cannot be entirely repressed, but scarcely excuses the omission in the present volume of references to certain foreign memoirs of the first importance.

An apology for its late appearance accompanies the volume, and we are led to infer that the delay may have been occasioned in some measure by the regrettable loss of Dr. Bodländer from the staff of contributors, whose place, it may be added, on the section of physical chemistry is now taken by Dr. A. Coehn.

J. B. C.

Elements of Applied Microscopy. By Charles-Edward Amory Winslow. Pp. xii + 183. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 6*s.* 6*d.* net.

This little book is planned on novel lines, and contains a good deal of information in a small compass. As it is primarily intended for class use, practical details are briefly dealt with, and more space is thus available for descriptions of the various objects which the microscopist is intended to study. The first three chapters deal with the theory, construction, and manipulation of the microscope, and the preparation and mounting of objects. Next, micrometry and the camera lucida are described, and the subsequent chapters are devoted to the microscopy of starches, of foods and drugs and their adulterants, the examination of textile fibres and of paper, forensic microscopy, microchemistry, and petrography and metallography. Sufficient information is given to stimulate the student's powers of observation and desire for further knowledge. The chapter on the microscopy of paper is a particularly good one. Altogether the book should usefully fulfil the object for which it has been written.

Auslese aus meiner Unterrichts- und Vorlesungspraxis. By Dr. H. Schubert. Zweiter Band. Pp. 218. (Leipzig: Göschen, 1905.) Price 4 marks.

This is a very entertaining instalment of Prof. Schubert's lectures. The first section deals with triangles having rational sides and areas, pyramids with rational edges and volumes, and similar subjects. Tables and formulæ are given which will be useful to those who wish to set neat numerical exercises in trigonometry and mensuration. Section ii. is devoted to continued fractions, the Pellian equation, expression of an integer (when possible) as the sum of two squares, and so on. Section iii. is on the elementary calculation of logarithms, and forms a supplement to a similar chapter in the first volume.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Secondary Röntgen Rays and Atomic Weight.

In papers on secondary Röntgen radiation and polarised Röntgen radiation I have shown that all the phenomena of secondary radiation (as indicated by an electroscope placed several centimetres from the radiator) may, from substances of low atomic weight, be accounted for by considering the corpuscles or electrons constituting the atoms, to be accelerated in the direction of electric displacement in each primary Röntgen pulse as it passes through such substances, and that the interaction between the corpuscles affects only to a small extent the character of the secondary radiation proceeding from the substance. In light atoms there is almost complete independence of motion of the corpuscles within the limits of disturbance produced by all primary beams experimented upon.

It was also shown (Nature, March 9, 1905) that this independence of motion disappears in heavier atoms in which there may be conceived to be a more intimate relation between the corpuscles, inter-corpuscular forces being brought into play which have the effect of widening the secondary pulses and producing accelerations in the corpuscles in directions other than those of electric displacement in the primary pulse. Until recently I have been unable to make experiments on a sufficient number of elements of higher atomic weight to arrive at any law connecting the penetrating power of the secondary radiation with the atomic weight of the radiator. Recent investigation has, however, shown that beyond the region of atomic weights in which the character of secondary radiation is almost independent of the nature of the radiator, the absorbability of the radiation is a periodic function of the atomic weight, the periodicity agreeing so far as these experiments have gone with the periodicity in chemical properties.

A detailed account of these results will be published shortly.

They, however, afford striking evidence of a connection between chemical properties and distribution of corpuscles in the atom, such as Prof. J. J. Thomson suggests in his conception of the constitution of the atom; for the character of the secondary radiation set up by a given primary can only, according to the theory which has been shown to account for all the phenomena I have hitherto observed, be affected by the relation between the radiating corpuscle and its neighbours.

The results also suggest a method of determining atomic weights by interpolation, for a small variation in atomic weight is usually accompanied by a very considerable change in absorbability of the secondary radiation, and though in these experiments great accuracy has not been essential, it appears that in many regions a variation of atomic weight by much less than 1 would be indicated.

The experiments are being continued.

Charles G. Barkla.

University of Liverpool, February 9.

The Falkland Island Fox.

In a review in the current number of Nature of Mr. Renshaw's "Some Mammalian Types," reference is made to the "Antarctic wolf of the Falkland Islands exterminated by the sheep farmers in self defence." Might I be permitted to add a word on this subject in correction of an erroneous impression current among many naturalists with regard to this animal? During a visit to the Falkland Islands in 1903, and again in 1904, I made careful inquiries with regard to the native wolf or fox. The oldest sheep farmers in the islands, men who remembered when the fox was still plentiful, insisted that it was quite a mistake to credit it with attacking sheep; this never occurred, and the reason that the farmers waged war against the foxes was because the sheep, apparently mistaking them for dogs, especially at night, in their terror ran into the bogs and swamps which abound in the islands and were consequently lost. None of the farmers whose experience went back to the time of these foxes had any memory of sheep being killed or even mauled by them. In making this correction, I must say that I have not seen Mr. Renshaw's book, and consequently do not know what reason he attributes for the extermination of the fox.

R. N. Rudmose-Brown.

Scottish National Antarctic Expedition, Edinburgh, February 10.

Chinese Names of Colours.

On the interesting observation on Chinese names of colours of Mr. H. Crook, in Nature (January 11), I would add this little information. Prof. Giles in his great dictionary gives (No. 4845) 雪青 as "a very light violet colour"; Wells Williams (p. 820) as "a purple colour." Mr. de Zelinski and Clémence Royer, in an interesting note "Sur les noms des couleurs en japonais" ("Congrès internat. des Orientalistes, Compte rendu de la 1ère session, Paris, 1873, vol. i., pp. 83–87), give another example, in Japanese, of the same kind.

浅葱 (*asagi*), literally "*a light yellow*," signifies, following Prof. de Rosny, "*bleu de ciel*"! Mr. Hepburn, in his Japanese dictionary, fifth edition, Tokyo, 1894, renders the same expression by "*a light green or pale colour.*"

Analogous oddities can also be found in European languages, as the French "*azur cendré*," or "*une rose* (the flower) *jaune*," &c.

Giovanni Vacca.

Firenze, Via Ricasoli 49, Italy.

NOTES ON SOME CORNISH CIRCLES.

The Merry Maidens, Lat. 50° 4′ N.

ONE of the best preserved circles that I know of is near Penzance. It is called the Merry Maidens[1] (Dawns-Maen), and is thus described by Lukis[2] (p. 1):—

"This very perfect Circle, which is 75 feet 8 inches in diameter, stands in a cultivated field which slopes gently to the south.

"It consists of 19 granite stones placed at tolerably regular distances from each other, but there is a gap on the east side, where another stone was most probably once erected.

"Many of the stones are rectangular in plan at the ground level, vary from 3 feet 3 inches to 4 feet in height, and are separated by a space of from 10 to 12 feet. There is a somewhat shorter interval between four of the stones on the south side.

"In the vicinity of this monument are two monoliths called the Pipers; another called Goon-Rith; a holed stone (not long ago there were two others); and several [5] Cairns."

Lukis thus describes "the Pipers":—

"Two rude stone pillars of granite stand erect, 317 feet apart, and about 400 yards to the north-east of the Circle of Dawns-Maen. No. 1 is 15 feet high, 4 feet 6 inches in breadth, and has an average thickness of 22 inches, and is 2 feet 9 inches out of the perpendicular. The stone is of a laminated nature, and a thin fragment has flaked off from the upper part. No. 2 is 13 feet 6 inches high, and is much split perpendicularly. At the ground level its plan in section is nearly a square of about 3 feet."

Goon-Rith is next described:—"No 3 is naturally of a rectangular form in plan, and is 10 feet 6 inches in height. The land on which it stands is called Goon-Rith, or Red Downs. The upper part of the stone is of irregular shape."

Borlase, in his "History of Cornwall" (1769), only mentions the circle, but W. C. Borlase in his "Nænia Cornubiæ" (1872) gives a very rough plan including the stones before mentioned and several barrows, some of which have been ploughed up.

At varying distances from the circle and in widely different azimuths are other standing stones, ancient crosses and holed stones, while some of the barrows can still be traced.

The descriptions of the locality given by Borlase and Lukis, however, do not exhaust the points of interest. Edmonds[1] writes as follows:—

"A cave still perfect . . . is on an eminence in the tenement of Boleit (Boleigh) in St. Buryan, and about a furlong south-west of the village of Trewoofe (Trove). It is called the 'Fowgow,' and consists of a trench 6 feet deep and 36 long, faced on each side with unhewn and uncemented stones, across which, to serve as a roof, long stone posts or slabs are laid covered with thick turf planted with furze. The breadth of the cave is about 5 feet. On its north-west side, near the south-west end, a narrow passage leads into a branch cave of considerable extent, constructed in the same manner. At the south-west end is an entrance by a descending path; but this, as well as the cave itself, is so well concealed by the furze that the whole looks like an ordinary furze break without any way into it. The direction of the line of this cave is about north-east and south-west, which line, if continued towards the south-west, would pass close to the two ancient pillars called the Pipers, and the Druidical temple of Dawns Myin, all within half of a mile."

Photo. by Lady Lockyer.

FIG. 1—The Merry Maidens (looking East).

This fougou is situated on a hill on the other side of the Lamorna Valley, near the village of Castallack, and the site of the Roundago shown in the 1-inch ordnance map.

Borlase[2] says that many similar caves were to be seen "in these parts" in his time, and others had been destroyed by converting the stones to other uses.

There is evidence that the circle conditions at the Merry Maidens were once similar to those at Stenness, Stanton Drew, the Hurlers, Tregaseal, and Botallack, that is that there was more than one, the numbers running from 2 to 7. Mr. Horton Bolitho, without whose aid in local investigations this paper in all probability would never have been written, in one of his visits came across "the oldest inhabitant," who remembered a second circle. He said, "It was covered with furze and never shown to antiquarians"; ultimately the field in which it stood was

[1] I may here remark that "9 maidens" is very common as a name for a circle in Cornwall. It is a short title for 19 maidens. Lukis implies that Dawns-Maen once consisted of 20 stones. If all the circles followed suit it would be interesting to note if the oresent number of 19 is always associated with a gap on the eastern sides. The "pipers" are, of course, the musicians who keep the maidens merry, as does the "blind fiddler" at Boscowen-un Circle.

[2] "Prehistoric Stone Monuments, Cornwall.

[1] "The Land's End District," p. 46.

[2] "Antiquities," p. 274.

ploughed up and the stones removed. It is to prevent a similar fate happening to the "Merry Maidens" themselves that Lord Falmouth will not allow the field in which they stand to be ploughed, and all antiquarians certainly owe him a debt of gratitude for this and other proofs of his interest in antiquities. Mr. Bolitho carefully marked the site thus indicated on a copy of the 25-inch map. I shall subsequently show that the circle which formerly existed here, like the others named, was located on an important sight-line.

Mr. Horton Bolitho was good enough to make a careful examination of the barrows A and B of Borlase.[1] In A (S. 69° W.) he found a long stone still lying in the barrow, suggesting that the barrow had been built round it, and that the apex of the barrow formed a new alignment. In B there is either another recumbent long stone or the capstone of a dolmen. This suggests work for the local antiquarians.

I should state that there may be some doubt about barrow A, for there are two not far from each other with approximate azimuths S. 69° W. and S. 64° W. The destruction of these and other barrows was probably the accompaniment of the reclamation of waste lands and the consequent interference with antiquities which in Cornwall has mostly taken place since 1800.

But it did not begin then, nor has it been confined to barrows. Dr. Borlase in his parochial memoranda under date September 29, 1752, describes a monolith 20 feet above ground, and planted 4 feet in it, the "Men Peru" (stone of sorrow) in the parish of Constantine. A farmer acknowledged that he had cut it up, and had made twenty gate-posts out of it.

My wife and I visited the Merry Maidens at Easter, 1905, for the purpose of making a reconnaissance. Mr. Horton Bolitho and Mr. Cornish were good enough to accompany us.

On my return to London I began work on the 25-inch Ordnance map, and subsequently Colonel R. C. Hellard, R.E., director of the Ordnance Survey, was kind enough to send me the true azimuths of the Pipers. In October, 1905, Mr. Horton Bolitho and Captain Henderson, whose help at the Hurlers I have already had an opportunity of acknowledging, made a much more complete survey of the adjacent standing stones and barrows.

In this survey they not only made use of the 25-inch map, but of the old plan given by W. C. Borlase dating from about 1870. Although the outstanding stones shown by Borlase remain, some of the barrows indicated by him have disappeared.

In January, 1906, my wife and I paid other visits to the monuments, and Mr. Horton Bolitho was again good enough to accompany us. Thanks to him permission had been obtained to break an opening in the high wall-boundary which prevented any view along the "Pipers" sight-line. I may here add that unfortunately in Cornwall the field boundaries often consist of high stone walls topped by furze, so that the outstanding stones once visible from the circles can now no longer be seen from them; another trouble is that from this cause the angular height of the sky-line along the alignment cannot be measured in many cases.

I will now proceed to refer to the chief sight-lines seriatim. The first is that connecting the circle which still exists with the site of the ancient one. On this line exactly I found four points, a barrow (L) which Borlase had missed (further from the circle than his barrow A), the site, the present circle, and the fougou; azimuth from centre of circle N. 64° E. and S. 64° W. This is the May year line found at Stonehenge, Stenness, the Hurlers and Stanton Drew.

In connection with this there is another sight-line which must not be passed over; from the circle the bearing of the church of St. Burian is about N. 64° W.; like the fougou it is situated on a hill, and near it are ancient crosses which I suspect were menhirs first and crosses afterwards.[1] However this may be, we see in this azimuth of 64° three times repeated that the May and August sunrises and sunsets and the February and November sunsets were provided for.

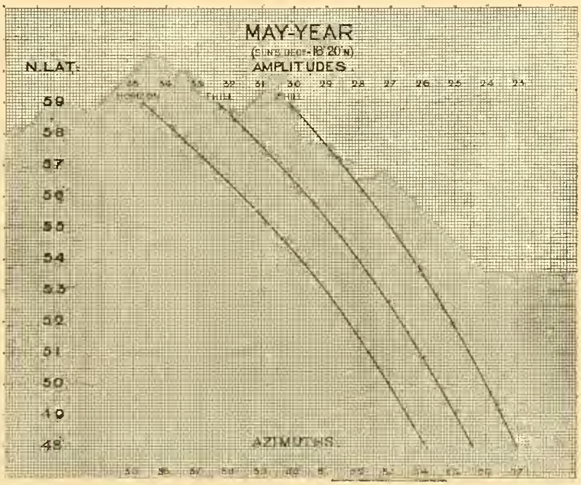


FIG. 2.—The place of the May sunrise in British latitudes.

With regard to the other sight-lines I will begin with that of the Pipers as it is quite obviously connected with the eastern circle only; the stones could not have been seen from the other on account of rising ground. The barrow shown in this direction by Borlase has now entirely disappeared, and the earth has evidently been spread over the surrounding field; its surface is therefore higher than formerly, so that when the opening was made in the wall the top of the nearest piper could not be seen from the centre of the circle; an elevation of about 2 feet from the

[1] "Nænia," p. 214.

[1] In A.D. 658 a council assembled at Nantes decreed:—"As in remote places and in woodlands there stand certain stones which the people often worship, and at which vows are made, and to which oblations are presented—we decree that they be all cast down and concealed in such a place that their worshippers may not be able to find them."

"Now the carrying out of their order was left to the country parsons, and partly because they had themselves been brought up to respect these stones, and partly because the execution of the decree would have brought down a storm upon their heads, they contented themselves with putting a cross on top of the stones."—"Book of Brittany," by Baring-Gould, p. 20.

ground level was necessary. Walking straight from the circle to the first piper, the second piper was exactly in a line, though at a much lower level. This showed that the ordnance values were not quite accurate, which was not to be wondered at as no direct observation had been possible. I therefore adopted the mean of the ordnance values as the true azimuth:—

	°	′	″	
Piper 1.—N.	37	58	36	E.
Piper 2.—	38	52	36	
Mean	38	25	36	

The sky-line from the centre of the circle was defined by the site of the vanished barrow, angular elevation 20′, and it is highly probable that the function of the barrow when built was to provide a new sight-line when the star-rise place was no longer exactly pointed out by the piper line.

With these data the star in question was Capella, dec. 29° 58′ N., heralding the February sunrise, 2160 B.C.

I next come to the famous menhir Goon-Rith. The conditions are as follows: from the circle Az. S. 81° 35′ W. Altitude of sky-line 34′.

Concerning this alignment from the circle, it may be stated that it cuts across many ancient stones, including one resembling a rock basin or laver, and another either a holed stone or the socket of a stone cross. I suspect also the presence in old days of a holy well attached to the circle, for there is a pool of water in a depression which is shown in the 25-inch map.

I regard it as quite possible that we are here in presence of the remains of a cursus, an old *via sacra*, for processions between the circle and the monolith.

I have not been able to find any astronomical use for this stone from the circle or from the site of the old one, but if we suppose it to have been used like the Barnstone at Stenness for observations *over* the circle its use at once becomes obvious.

From the azimuth given, the declination of the star was 5° 24′ N. Now this was the position of the Pleiades B.C. 1960, when they would have warned the rising of the May sun.

So that it is possible that the erection of the Pipers and of Goon-Rith took place at about the same time, and represent the first operations.

The next alignment has an azimuth of S. 69° W.; from the circle, it would be the same within a degree from the site of the one which has disappeared, altitude of sky-line 18′; this line is to a stone cross on rising ground, doubtless a re-dressing of an old menhir, and on the line nearer the circle are the remains of a barrow.

With these data the star in question was Antares, dec. S. 13° 18′, heralding the May sunrise 1310 B.C.

There is another stone cross defining a line az. N. 11° 45′ E. from the circle, altitude of sky-line about the same as along the piper azimuth; an intervening house prevents measurement. These values give us N. dec. 38° 46′, referring to Arcturus warning the August sunrise in 1640 B.C.

The three alignments already referred to, then, give us the warning stars for three out of the four quarter days of the May year, the astronomical conditions of which in Cornwall are shown in the accompanying diagrams.

NORMAN LOCKYER.

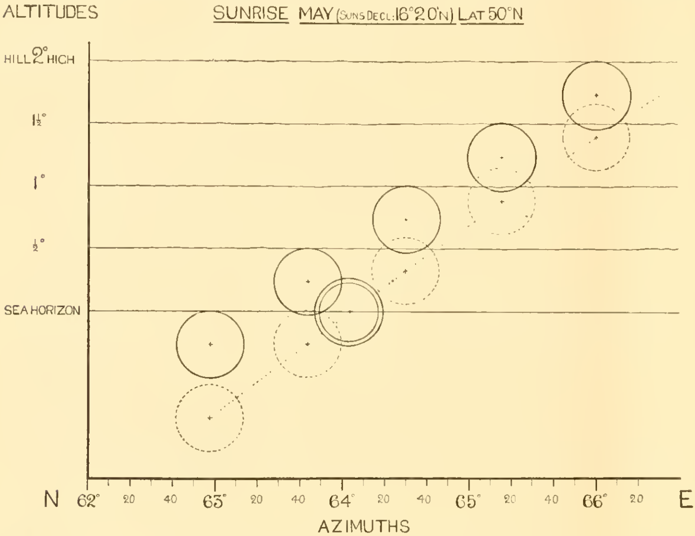


FIG. —Showing the influence of the height of the sky-line on the apparent place of sunrise. The double circle shows the tabular place of sun's centre.

THE SERUM THERAPY OF PLAGUE.

THE discovery of diphtheria antitoxin and the excellent results obtained with it in practice, which in the Metropolitan Asylums Board hospitals has resulted in a reduction in the case-mortality from about 29 to 11 per cent., raised hopes that a panacea had at last been found for all microbic diseases. But it must be confessed that expectations have not been realised, and as regards other therapeutic sera none has proved nearly so efficacious as the diphtheria serum.

Several reasons may be given for this. The antitoxic sera, *i.e.* therapeutic sera prepared by the injection of bacterial toxins, are much more potent than anti-microbic sera, and possess antidotal properties proportional to their strength. But unfortunately most micro-organisms do not produce an extra-cellular toxin, like the diphtheria bacillus does; the toxic substances are more or less intimately associated with the bacterial cells, as in staphylococcic and streptococcic (septic) infections, typhoid, plague, &c. Now

the anti-microbic sera seem to neutralise through the interaction of two substances, one present in the serum, the other a constituent of the patient's body and limited in amount, so that when the whole of the latter has taken part in the neutralisation, no additional amount of the therapeutic serum produces a further neutralisation.

Again, an anti-streptococcic serum prepared with streptococcus A, though active against A, does not necessarily neutralise another streptococcus B. In diphtheria also, a local and visible lesion generally enables a diagnosis to be made, and serum treatment to be applied, before any great amount of tissue damage has been done, whereas in tetanus, for which a very potent antitoxin has also been prepared, it is the results of tissue damage which lead to a diagnosis. No therapeutic serum can, of course, *repair* tissue damage, and if this has proceeded beyond a certain degree the condition becomes incompatible with life. It is noteworthy that even in diphtheria, if treatment be delayed beyond the third day, antitoxic treatment produces results little better than treatment without antitoxin, tissue damage having proceeded to too great an extent during the interval.

The fearful prevalence of plague in India during the last few years, which has caused the death of hundreds of thousands of the inhabitants of that great Empire, has naturally directed attention to the serum therapy of this disease, since no ordinary form of treatment has any particularly beneficial effect, and the Government of India has therefore been well advised to devote one of its scientific memoirs [1] to the subject, under the editorship of Lieut.-Col. Bannerman, M.D., I.M.S., who has had much experience of plague. Various forms of anti-plague serum were the subjects of trial, the Roux-Yersin, Lustig, Haffkine, Terni, and Brazil, the details of the preparation of which are given, and tables of the results obtained. Col. Bannerman concludes from a study of the circumstances and of the case-mortality of the various series of cases treated with the different sera that (1) the Roux-Yersin serum did not affect the case-mortality in the slightest degree, (2) in three out of the four trials made with Lustig's serum the case-mortality of the serum cases was higher than among those receiving ordinary treatment, (3) with Haffkine's serum there is no certain evidence of its efficiency, (4) with Terni's serum there is a difference of 0.91 per cent. only in favour of the serum-treated cases, and (5) with Brazil's serum, though there is a difference of 2.85 per cent. in favour of the serum-treated cases, it is problematical if this can definitely be ascribed to the serum.

As regards case-mortality, therefore, these trials do not suggest that serum therapy in plague is of much, if of any, value, but clinically there is an amelioration in the symptoms, and the cases when treated with serum live for a longer period than without it. We might add that the series of cases treated with Terni's and with Brazil's serum (110 and 70 respectively) are too small to warrant any definite conclusions. Bannerman from these results considers that it will be necessary to commence anew the study of the serum therapy of plague, and with this we cordially agree. At the same time we cannot help thinking that it would be desirable to make a much more extended use than has been done of the intravenous method of administration of the serum.

R. T. HEWLETT.

[1] *Scientific Memoirs of the Government of India*, No. 20, 1905. Serum Therapy of Plague in India. Reports by Mr. W. M. Haffkine, C.I.E., and various Officers of the Plague Research Laboratory, Bombay. Edited with an Introduction by Lieut.-Col. Bannerman, M.D., B.Sc., I.M.S., Director, Plague Research Laboratory, Bombay.

SEA COAST PROTECTION.

A CONFERENCE of local authorities having districts situated on the seaboard of England was held in London on February 6 on the subject of the defence of the coasts against erosion by the sea, and the national responsibility in regard to the matter. This conference was convened by the chairman of the Herne Bay District Council. The matter had been taken up by the sea-side towns on the east coast in 1903, and a deputation was then appointed to wait on Mr. Balfour, but nothing came of this. The conference recently held consisted chiefly of representatives of towns on the south coast, and a resolution was adopted "That representatives of this conference be appointed to approach the Prime Minister and President of the Board of Trade, to request the Government to introduce into Parliament a Bill declaratory of the aforementioned principles and defining ways and means whereby some relief towards, or allowance in respect of, the cost and maintenance of protective works might be contributed by the Government." The report of the meeting that appeared in the public journals does not say what "the aforementioned principles" consist of.

The members who attended this conference consisted almost entirely of representatives of sea-side towns, where promenades and similar works have been constructed for the purpose of enhancing the attractions of these places.

The *Engineer*, in an article on this conference, points out that to protect efficiently long stretches of purely agricultural land, the sea margin of which consists of friable and easily eroded material exposed to the inroads of the sea, would (as shown in the book on "The Sea Coast," published by Messrs. Longmans and Co.) involve a capital and maintenance expenditure out of proportion to the advantages secured, the value of the land preserved during the life of the protective works not being equal to one-third of the outlay required for protecting it.

In the case of sea-side resorts or other localities where the coast-line is of considerable value, the *Engineer* points out that while the preservation of the littoral is an absolute necessity, the benefits to be derived by protection are almost wholly local, and the owners of agricultural land not worth the cost of protection would have a perfectly legitimate grievance if Imperial funds were spent for the benefit of their wealthier neighbours. It may also be added that all inland towns would have an equal right to protest against contributing towards money spent on these sea-side towns, where promenades and other works have been constructed to attract visitors, and thereby have enormously increased the value of the property of those whose land is adjacent.

There was one part of the subject of coast erosion alluded to at the meeting which might with more reason be pressed on the attention of the Government, that is, the prevention of the removal of sand and shingle from the beach, which now forms a natural protection to the shore. As the law now stands, the Board of Trade, on being applied to, will order a local inquiry where complaint is made of injury done by such removal, and if as the result of such inquiry it is shown that such removal is injurious, the Board can, under its statutory powers, issue an order forbidding any further removal. The cost of these inquiries, however, is considerable.

In some cases the Government itself is the offender, shingle being taken for making concrete for its coast works. In many cases the local authorities, who are now asking for State relief, have been the worst offenders in this respect, by placing their sea walls so

as to shut in the natural shingle banks behind the walls or using the material from them for their works.

The Government might justly be asked to obtain such an alteration in the existing law as would make any removal unlawful unless it could be shown that such removal would not in any way be injurious to adjacent property, and making it the duty of the coastguards to report where any removal of shingle or sand is taking place.

NOTES.

THE present year will witness the fiftieth anniversary of the foundation of a great branch of chemical industry which, perhaps more than any other discovery in applied chemistry, has reacted upon the science itself to its lasting benefit. Half a century ago the first artificial colouring matter obtained from a coal-tar product was discovered and manufactured by William Henry Perkin under the trade name of "Mauve." The subsequent development of the coal-tar colour industry has been one continuous series of triumphs, and the colossal scale on which organic compounds of great complexity are now manufactured, often in a state approaching chemical purity, cannot but strike the future historian of scientific industry as one of the most marvellous achievements of applied organic chemistry of the present age. The marvel is enhanced when it is borne in mind that the whole of this industrial development, which has been made possible by the intervention of pure science at every stage, has taken place during the last half-century. The founder of the industry, Dr. Perkin, is happily still with us in full vigour, and a movement is now being organised to celebrate the jubilee of the discovery and to do honour to the discoverer. Preliminary meetings have been held under the auspices of the Chemical Society and a provisional committee formed, which committee has prepared a scheme for submission to a public meeting for adoption at the Mansion House on February 26 at 3 p.m., when the Lord Mayor has consented to take the chair. That the importance of the movement is being appreciated in this country is shown by the fact that, in addition to all the leading chemists and manufacturing chemists, the committee already comprises the names of Lords Halsbury, Rayleigh, Alverstone, and Avebury, the Right Hons. R. B. Haldane, A. J. Balfour, and Joseph Chamberlain, and representatives of the universities, Royal Society, the City companies, &c. The appreciation, moreover, is not limited to Perkin's own countrymen, and it is known that when the scheme has been formally adopted at the Mansion House meeting on February 26 other countries, and especially Germany, the present headquarters of the industry, will participate in the movement. Those who are interested in the scheme are invited to attend the meeting. The secretary to the committee is Prof. A. G. Green, of Leeds University, from whom particulars can be obtained.

A PORTRAIT of Dr. H. C. Sorby, F.R.S., subscribed for privately, and presented by the subscribers to the University of Sheffield, in commemoration of Dr. Sorby's scientific work and labours as one of the founders of the university, was unveiled on Monday, in the presence of a large assembly of leading citizens and other admirers of his devotion to scientific research and to the cause of higher education in Sheffield. Alderman Franklin, as president of the university council, opened the proceedings, and the portrait was unveiled by the Lady Mayoress. Mr. Simeon Snell and Prof. W. M. Hicks, F.R.S., who organised the movement for the presentation, in asking the University to accept the portrait, referred to Dr. Sorby's long association with Sheffield—he might, in fact, be regarded as the Dalton or the Priestley of Sheffield—and to his sixty years of active work for the advancement of science and the extension of natural knowledge. The state of Dr. Sorby's bodily health prevented him from being present at the ceremony, but he expressed his appreciation of the honour in a letter to Alderman Franklin. The portrait is a replica of one painted by Mrs. M. L. Waller, and now hanging in the rooms of the Sheffield Literary and Philosophical Society.

THE gold medal of the Royal Astronomical Society has this year been awarded to Prof. W. W. Campbell, of the Lick Observatory, for his spectroscopic researches on the motions of stars in the line of sight. The medal was presented at the eighty-sixth anniversary meeting of the society on February 9, when the American Ambassador, Mr. Whitelaw Reid, received the medal on behalf of Prof. Campbell, who was unable to be present. Mr. Whitelaw Reid, in accepting the medal on Prof. Campbell's behalf, said he would certainly value the decoration as highly as a soldier or statesman would value one sent him by a Sovereign. The United States is proud of every advance in art or science made by her sons—prouder of these than of triumphs in trade or in war—and it will be gratified that this high recognition for service to one of the noblest of sciences came from a land to which they are so closely related.——It may be remarked that this is the third consecutive year that this medal has been awarded to an American astronomer. In fact, Mr. Choate, the late American Ambassador, in receiving the medal for Prof. Lewis Boss last year, remarked that it seemed quite one of the annual duties of the Ambassador to proceed to the rooms of the Royal Astronomical Society to receive the gold medal. Out of the list of the last thirteen medallists, no less than seven hail from the United States.

ACTIVE steps are being taken at York to ensure the success of the meeting of the British Association to be held there next August. Last Saturday, at a large and distinguished assembly, over which the Lord Mayor of York presided, the arrangements in connection with the forthcoming visit were advanced a further stage. A reception committee representative of the city and county was elected, and it was resolved to raise a fund of not less than 250*l*. for the necessary expenses of the meeting. In an appropriate speech, the Lord Mayor moved "That this meeting agrees cordially to welcome the British Association to York this year from August 1–8, and in doing so attaches special interest to the fact that the Association began its existence in York seventy-five years ago." The Dean of York seconded this resolution (which was carried unanimously); and in supporting it Dr. Tempest Anderson referred to local connections with the association, the first officials of which included some of the leading members of the Yorkshire Philosophical Society. The local reception committee appointed on Saturday is an unusually strong one: the president is the Lord Archbishop of York; chairman, the Lord Mayor (Mr. R. H. V. Wragge); vice-chairman, Dr. Tempest Anderson; treasurer, Sir J. Sykes Rymer; and secretaries, Mr. R. Percy Dale and Mr. C. E. Elmhirst. Pro-Chancellor A. G. Lupton (University of Leeds) and Prof. W. M. Hicks (University of Sheffield) both spoke at the meeting, and expressed the desire of their universities to assist in making the forthcoming meeting of the association a success.

Sir William Crookes has been elected a corresponding member of the physical section of the Paris Academy of Sciences in succession to the late M. Bichat.

The second congress of the German Röntgen Society will be held at Berlin on April 1–2, under the presidency of Prof. Eberlein.

The largest steel ingot ever made was cast at Manchester on February 1. It weighed no less than 120 tons, and was cast on the Whitworth system of fluid compression. The 120 tons of molten steel were subjected to a pressure of 12,000 tons in order to make the ingot homogeneous and sound throughout.

In order to lessen the smoke and soot nuisance in the town of Helsingfors, the municipal authorities have appointed an engineer, Mr. Ed. Cedercreutz, first to examine and test the boiler and furnace installations in the town, and then to propose suitable means for diminishing the above mentioned source of annoyance.

In honour of the late Prof. Edouard Grimaux, who by reason of his numerous chemical researches, and particularly his contributions on the atomic theory, has taken a high place among French men of science, it is proposed to erect some form of memorial in his native town of Rochefort-sur-Mer. Contributions to the memorial fund are to be addressed to the Mayor of Rochefort, M. E. Marianelli.

The Society of German Portland Cement Manufacturers will hold its twenty-ninth general meeting in Berlin on February 16–17. On the agenda list are the following papers, amongst others:—Report from the society's laboratory, Dr. Framm, of Karlshorst; report of the sea-water commission, Dr. Eng. Rudolf Dyckerhoff, of Amöneburg; report of the committee for examining the change of volume and the time of binding of Portland cement, Dr. Müller, of Rüdersdorf; hydraulic binding appliances, Dr. Goslich, of Züllchow; rotating furnaces, Dr. Michaëlis, sen., of Berlin; the acidity of water and its removal, Mr. H. Wehner, of Kissingen.

On January 28, at Stensjöholm, near Ryssby, in Sweden, the agricultural chemist Prof. Alexander Müller died in his seventy-eighth year. A native-born German, Müller received his early education in Chemnitz and Freiburg, and at the University of Leipzig. In 1851 he was appointed lecturer in chemistry at the Trade School in Chemnitz; from there, in 1856, he was appointed director of the agricultural experimental section of the Landbruks Academy in Stockholm, and consulting agricultural adviser for Sweden and Norway. In this capacity Müller displayed great ingenuity in conducting numerous practical experimental investigations for the welfare of Scandinavian agriculture. The earliest of his published researches dealt chiefly with dairy methods, hygienic questions, and the proper working of various soils. In later years he occupied himself mainly with questions relating to the cleansing of towns, and, indeed, published a number of papers on this subject.

By the death on January 13, at the early age of forty-six, of Prof. A. S. Popow, physical science in general, and Russian science in particular, has lost one of the pioneer band of physicists in the field of wireless telegraphy. After studying at the St. Petersburg University from 1877 to 1883, Prof. Popow was appointed first an assistant, and later professor of physics in the Mining School for Officers at Kronstadt, whilst he also delivered lectures at the Technical High School for the Russian Marine from 1890 to 1901. His zeal for work was extraordinary; although he devoted himself strenuously to experimental work in different branches of electrotechnics, he also found time to superintend the electrical station at Nijni Novgorod, whither he betook himself each summer. His work in 1895 was particularly rich in results, for in the summer of that year he succeeded in signalling over long distances by means of electromagnetic waves, and also invented an apparatus for graphically indicating and recording storms, which in 1896 was introduced into the meteorological observatory of the St. Petersburg Forest Academy, whilst the Parisian firm of Dacretoit constructed a receiving station for wireless telegraphy according to Popow's plans, which have been taken as a model for the installation throughout the Russian Marine. In 1905 Popow was appointed professor of physics at the electrochemical institute in St. Petersburg, and on September 28, 1905, on the declaration of the academic freedom of Russian universities, he was elected director of the institute. Popow's intellectual gifts, his attachment to scientific research, and geniality of intercourse at all times, secured for him the warmest sympathy and respect from both colleagues and students.

In reply to the request made by Prof. S. P. Thompson in last week's Nature (p. 340) for the dates of birth and death of William Nicol, the inventor of the Nicol prism, two correspondents state that Nicol was born about 1768 and died in 1851 at Edinburgh, where he was a teacher of physics. (See the "Century Cyclopedia of Names" published by the *Times*, p. 737.)

It is announced by *Science* that there is a movement being started to present to the City of Philadelphia a statue of Dr. Joseph Leidy. Dr. Leidy, who was born in that city in 1823, and died there in 1891, added much to its scientific eminence, and as president of the Academy of Natural Sciences, professor of human and comparative anatomy and zoology in the University of Pennsylvania, and president of the Wagner Free Institute of Science, accomplished much for these institutions.

The Cairo correspondent of the *Times* states that Mr. T. Barron, the geological surveyor to the Anglo-Sudan Administration, died on January 31 at El Koweit. While in the Survey Department of the Public Works Ministry in Cairo, Mr. Barron rendered excellent services in revising the geology of the country between Cairo and Suez. In 1904 Mr. Barron's services were lent to the Sudan Government, and part of the work with which he was then entrusted included the investigation of the lignite deposits of Tchelga, in north-west Abyssinia. He eventually joined the Sudan service.

Dr. C. G. Seligmann, Hunterian professor for 1906, delivered the first of his three lectures on Monday in the theatre of the Royal College of Surgeons, and took as his subject the "Physical Anthropology and Ethnology of British New Guinea." After directing attention to the general features of New Guinea, Dr. Seligmann proceeded to classify the natives of British New Guinea into four main stocks, Papuo-Melanesian in the south-east, Motuan around Port Moresby, Eastern Papuan in the hinterland or mountainous region, and West Papuan in the large western area, much of which is still unknown. The lecturer pointed out that there were linguistic and other resemblances between his Papuo-Melanesian stock and the island Melanesians, particularly those of the Solomon Islands. There is an area of brachycephaly on the west

of the Papuan Gulf for which it is very difficult to account; members of this stock seem to form part of the population south of the Fly River. The average stature rises in proceeding from the centre of the Gulf eastwards. There is no reason to suspect Australian influence, even in the Torres Straits Islands.—The lectures are open to the public; the second was given yesterday, and the concluding one will be delivered to-morrow (Friday) at five o'clock.

PROF. S. H. REYNOLDS, University College, Bristol, informs us that the rock fall at Cheddar on the night of Sunday, February 4, is not a matter of any very great moment, though much has been made of it in the papers. The point at which it took place is a quarry on the northern or dip slope side of the gorge, which here follows the strike of the rocks. The fallen rock detached itself from the quarry face along the bend of a master joint, and estimates of its amount vary from 70,000 tons to 500,000 tons; but an experienced quarry owner has assured Prof. Reynolds that 20,000 tons is about the amount of the fall. Though this may seem a very large amount, the fall is entirely confined to the face of the quarry, and the general features and beauty of the gorge are absolutely unaffected by it.

FIG. 1.—The recent rock-fall at Cheddar.

IN the annual report on British New Guinea for 1903, Sir F. Winter described a people on the Musa River, named Agaiambo; according to the newspaper reports of the period they are web-footed dwarfs; subsequent information went to show that they had been wiped out by a hostile tribe. The latest report, for 1904–5, shows that this latter item was incorrect, for ten members of the tribe have been measured by Captain Barton, and their photographs sent to Sydney. Unfortunately, much of the latest information is contradictory of the earlier report; the Agaiambo are stated to kneel in their canoes or sit on their heels, and to this circumstance their physical peculiarities are attributed; but Sir F. Winter says that they stand. Moreover, it is difficult to see how sitting on the heel could produce, as alleged, a protrusion of the heel. There is no evidence to show that the tribe is web-footed; they are not dwarfs; the man seen by Sir F. Winter stood as high as an ordinary native; what was peculiar about him was that the lower extremities were badly developed, so that his hips were 3 inches lower than those of the ordinary native. This feature seems to be borne out by the later evidence. There is no reason at present to suppose that they are of different stock from their neighbours; they are said to speak the same language as the Barigi, with whom they barter produce.

IN a paper on library aids to mathematical research, published in the *Proceedings of the Royal Society of Edinburgh*, Dr. Thomas Muir has touched upon a subject of ever-growing importance that has not yet received the systematic attention in this country which it needs. It deals with the requirements of the scientific investigator classed under the two general main categories of books and books about books. The paper is confined to the single subject of mathematics, with reference to Scotland in particular, but, as Dr. Muir remarks, "there can be no doubt, however, that other subjects are in as bad a plight, and that the whole question of library aid is worth serious and prompt attention from all scientific men." Commencing with "books about books," or summaries of existing literature, and excluding the "Bibliotheca Mathematica," which is different in scope, Dr. Muir finds that the mathematician is adequately provided for as regards past literature by Poggendorff's "Handwörterbuch" and the Royal Society catalogues, and as regards current literature by the "Jahrbuch über die Fortschritte," the Amsterdam "Revue semestrelle," and the "International Catalogue of Scientific Literature." But when it comes to the books themselves, the present state of affairs is eminently unsatisfactory. Confining his attention to the sixty-seven serials, mainly mathematical, included in the list published in the "International Catalogue, A" for 1903, Dr. Muir tabulates the state of affairs in the libraries of the University and Royal Society of Edinburgh and the University and Philosophical Society of Glasgow. He finds that only thirty-four of the sixty-seven periodicals are to be found in the combined libraries of southern Scotland, and many sets are incomplete, but that a considerable duplication exists in the libraries in question. Austrian mathematics is unrepresented. An annual expenditure of 100*l.* would suffice to purchase and preserve all the serials on the list, but even without any expenditure whatever the whole object could be attained by cooperation between the several libraries and gradual elimination of the cases of duplication. Dr. Muir considers that mathematical research at present can only be pursued in Scotland with difficulty and uncertainty, and that research in mathematical history is practically an impossibility. What Dr. Muir says regarding Scotland applies with still more force to libraries elsewhere. If he had extended his study, for example, to Wales, he would have found three separate libraries in the three university colleges each with only some 10*l.* or so per annum for purchase and binding of books and periodicals.

THE opening article in the January number of *Himmel und Erde* is devoted to the discussion of the question whether the attributes of organisms can be due to physical causes. In concluding this article, the author, Dr. V. Franz, of Breslau, points out that, although a physical origin of life is highly probable, its demonstration is a matter of almost insuperable difficulty.

IN the January issue of the *Museums Journal*, Mr. J. Minto discusses the relation of provincial museums to national institutions. After pointing out that local museums cannot at the present day grow with the requisite rapidity and properly discharge their educational functions if dependent solely upon donations, the author expresses himself as follows:—"It will take years to do away with

the idea of museums still entertained by many members of committees, as store-houses of curiosities, and to understand that museums must form part of the educational machinery of the nation."

WE reproduce from an article on the Florida Keys, published in the *National Geographic Magazine* for February, an exceedingly interesting photograph of an alligator's nest, showing a large number of eggs, from some of which young alligators have been hatched. In common

FIG. 1.—An alligator's n st, with newly-hatched alligators, in Fl rida. From the *National Geographic Magazine*.

with the caimans of Central and South America, the Mississippi alligator lays a number of eggs amid brushwood, which are carefully covered over with débris, and guarded during the period of incubation by the parent. In due course the young alligators are hatched, and soon make their way to the water, the nest, at least in the case of some of the Brazilian caimans, being opened by the female parent in order to facilitate the escape of her progeny.

IN an instructive article entitled "Saving California's Fruit Crops," published in the *Century Magazine* for February, the author, Mr. W. S. Harwood, dwells on the important services Mr. Compere has rendered to fruit-growers in America, and thus throughout the world, by his efforts to discover insects which will hold in check some of the most injurious insect fruit-pests. Mr. Compere's idea is that every injurious insect has an enemy in some part of the world, if only it can be found. He discovered, for instance, in Spain, a region where the codling-moth lives, but where the ravages of the worm to which its eggs give birth were slight. Investigation showed that this was due to an ichneumon-fly, by which the pest was kept in check. Naturally it was assumed that what held good for Spain would also be efficient in California, and a number of ichneumon-pupæ were accordingly packed and dispatched to the States. When the flies hatched they at once set to work on the codling-moth caterpillars, with the result that a swarm of young ichneumons has been produced, and it is hoped that in course of time the codling-moth pest may become a thing of the past. Another plan is to send a small tree of the species affected by a particular pest to the country where the enemy lives, whence it is returned to its native home provided with a stock of destroyers.

To the *American Naturalist* for January Lieut.-Colonel C. D. Durnford contributes an article (also published synchronously in this country in the *Annals and Magazine of Natural History*) on the flight of flying-fishes. In this it is maintained that the ordinary "aëroplane theory" of the flight of these fishes is based on an absolute mechanical impossibility, and that the real explanation is to be found in an intensely rapid vibration of the wing-like pectoral fins—a vibration which is revealed to the eye when the movement slows down as the fish touches the crest of a wave. In another article in the same journal Messrs. Dexler and Freund furnish some interesting information with regard to the mode of life of the dugong, noting also the various methods employed in the capture of these animals in Queensland. It is confirmed that dugongs do not voluntarily leave the water, while it is suggested that they seldom enter brackish, and are incapable of living in fresh water. Much interest attaches to the existence of a slimy coating for the protection of the eye, a similar coating also occurring in whales, although in the latter instance it is of an oily nature, in order to prevent its being too easily washed away by the sea-water.

IN *Macmillan's Magazine* for February, Mr. H. L. Puxley describes the unhygienic conditions which largely obtain in the production and distribution of milk, and suggests the precautions which should be taken to ensure a wholesome milk supply.

MESSRS. SANDERS AND CROWHURST, Shaftesbury Avenue, W., have submitted for our inspection a series of excellent lantern slides, and an album, entitled "Wild Birds at Home," of sixty beautiful reproductions of photographs taken with the "Birdland" camera, which has been made specially for natural history photography. A comparison of these life-like pictures—which are faithful representations of the actual environments of the birds depicted, untouched in any way by engravers—with the woodcuts which comparatively few years ago were the only illustrations available for works on natural history will demonstrate vividly the astonishing advances in pictorial illus-

FIG. 1.—Gannets on the wing. From a photograph taken with the "Birdland" Camera.

tration made possible by instruments like the "Birdland" camera in the hands of patient observers. Photographs of this high excellence both encourage and assist the study of animal life.

THE *Journal of Hygiene* for January (vi., No. 1) contains papers by Prof. Muir and Mr. Browning on anti-immune bodies and complementoids and on the action of comple-

ment as agglutinin, by Mr. MacConkey on a method for hastening the liquefaction of gelatin by the *B. clouceae*, by Dr. Boycott on the bacteriology of para-typhoid fever, and by Dr. Haldane on a portable apparatus for gas analysis. Dr. Sandilands writes on epidemic diarrhœa and the bacterial content of food, suggesting that flies may be the active agents in conveying this disease, no mention, however, being made of Dr. Nash's previous work in this direction. Prof. Ronald Ross directs attention to the occurrence of flagellated protozoan parasites in the mosquito (*C. fatigans*), which he suggests may invalidate Schaudinn's work on the development of the hæmosporidian *Halteridium danilewskyi* in this insect. Dr. Hamilton Wright also contributes a reply to Dr. Travers's criticism of preventive measures against beri-beri, which appeared in a former number of the Journal.

A SELECT list of works prepared at the Royal Botanic Gardens, Kew, by members of the staff, or in collaboration with them, has just been published as No. 1 of the *Kew Bulletin*, 1905. The list is extensive, as it goes so far back as 1859, when Grisebach's "Flora of the British West Indies" began to appear, and it includes Dr. Watt's "Dictionary of Economic Products of India" and the *Annals of Botany*. It is to be hoped that this number is a precursor to the resuscitation of the Bulletin.

FROM the Department of Agriculture, Nairobi, a leaflet, No. 10, has been issued on the insect and fungoid pests reported during the year 1904-5. The larvæ of a moth, *Spodoptera exempta*, destroyed the vegetation near Nairobi; a ladybird, *Epilachna similis*, is mentioned as doing great damage to maize and wheat; and several beetles and other insects were observed. Amongst fungi, wheat-rust proved fatal to the prospects of the wheat crop, dwarf beans suffered from rust and anthracnose, and the crop of chick-pea, *Cicer arietinum*, was completely destroyed by a *uredo*-fungus.

THE historic quotation connected with Darwin's examination of the primrose might well be repeated with reference to a posthumous paper on the oxlip by the late Prof. Errera, edited by Miss J. Wéry for the *Receuil de l'Institut botanique*, Brussels (vol. vi.). The paper furnishes a good illustration of Prof. Errera's talent for drawing deductions from simple experiments or observations. It was found that although the number of long-styled and short-styled plants was about equal, a bunch of flowers collected at random nearly always contained more of the long-styled, this being due to the slightly larger size of the flowers; the balance is maintained by the direct fertilisation of a larger number of short-styled flowers.

WE have received the report of the Meteorological Service of Canada for the year 1903. At the chief stations observations are taken day and night at equal intervals of time not exceeding four hours; at other stations they are taken three times daily, except in the case of those recording only rainfall and the general state of the weather. For the purpose of weather forecasts the country is divided into ten districts; the general success of fully or partially verified predictions amounted to 86 per cent. The results for the numerous stations are very carefully prepared, and include observations in Newfoundland, Labrador, and Bermuda, together with a chronicle of the chief characteristics of the weather in each month. Maximum shade temperatures of 99° were registered at Alberni, British Columbia, in June, Melfort, N.W. Territories, and St. Alban's, Manitoba, in July; minimum, −67°, at Good Hope, N.W. Territories, in February.

THE *U.S. Monthly Weather Review* for September last contains an account of the Japanese meteorological service in Korea and Manchuria. At the beginning of the Russo-Japanese war, Prof. Wada, who had been connected with the meteorological service of Japan since 1879, was entrusted by the Japanese Government with the organisation of a similar system in Korea and Manchuria, and is now completing the work as chief of that service; up to the present time fourteen stations have been established. A first-class observatory has been established at Chemulpo; the other stations, including Mukden, Fusan, and Port Arthur, are mostly of the second order. All the coast stations issue daily weather predictions, which are made known by means of flags; the central observatory issues storm warnings when an atmospheric disturbance is expected on or near the coasts of Korea and Manchuria, and day and night signals are immediately displayed at all stations.

IN view of the fact that acetylene gas is used in Germany to a very large extent, it is proposed to form a guild of acetylene apparatus owners for the purpose of collecting, arranging, and distributing information on methods of preparation and storing and on the uses of acetylene.

IT has long been known that the province of the Pechora is rich in mineral treasures. Quite recently a party of Russian and Belgian engineers examined the basin of the Ussa, and made rich finds of naphtha and copper ores. In fact, it is stated that the quantity of naphtha to be obtained from surface deposits in the Pechora district exceeds that present in the Caucasus, and is of a better quality, whilst the tonnage of easily workable copper ores is given as many millions. But for the working of these treasure-fields a large sum of money will be required, inasmuch as even the most primitive roads and methods of easy communication are practically unknown; also the population, and consequently the supply of labour, is extremely small. However, it is reported from St. Petersburg that energetic efforts are being made to obtain the necessary capital.

IN the *Lancet* for December 16, 1905, Dr. P. W. Latham describes a new method of directly transforming α-benzoyl-amino-*p*-hydroxycinnamic acid into tyrosine, by heating it with potassium cyanide, which acts as a reducing agent, and subsequently boiling the product with aqueous barium hydroxide. A theory, based on these observations, is advanced as to the method of formation of tyrosine in the animal body.

IN a note published in the *Annalen der Physik* (series 4, vol. xviii., p. 860), Prof. B. Walter recommends the use of a material called "picein," manufactured by the New York-Hamburg Indiarubber Company, as a cement for joining together pieces of physical apparatus; it is preferable to sealing-wax on account of the ease with which it can be worked, and the fact that it does not become brittle. As it is insoluble in water and alcohol, it can be used in contact with solutions prepared with these solvents, for example in absorption cells.

WE have received a reprint of a memoir by Prof. Augusto Righi, published in the *Memorie* of the Royal Academy of Sciences of Bologna (series vi., vol. ii., p. 151), in which full details are given of the method used in ascertaining the connection existing between the atomic weight of an element and the amount of secondary radiation it emits when subjected to the β and γ rays of radium; the results have already been noticed in NATURE (vol. lxxii. p. 350).

IN the *Atti dei Lincei* (series 5, vol. xiv., ii., 207) Prof. A. Righi describes a number of experiments which were made with the purpose of ascertaining the influence of the rays of radium on the resistance of certain solid and liquid dielectrics. A marked increase in the conductivity under the influence of the rays was observed in the case of liquid vaseline and olive oil, but with benzene, petroleum ether, and carbon bisulphide a much smaller effect was found. When solid colophony was subjected to the action of the rays, a change of conductivity could not be detected.

A WORK upon steam turbines, by Messrs. T. Stevens and H. M. Hobart, giving the most recent results in practice and having a concise account of the latest types, will be issued by Messrs. Whittaker and Co. in March.

MESSRS. SWAN SONNENSCHEIN AND CO., LTD., have now published the "Public Schools Year-book" for 1906, being the seventeenth issue of this important annual. Among other useful chapters which the volume contains, in addition to full particulars of 117 public schools, those dealing with engineering, medicine, agriculture, and horticulture as professions are of particular value to parents desiring occupations for their boys.

MR. FRANCIS HODGSON has published the third volume of the second series of the *Proceedings of the London Mathematical Society*. The volume runs to 482 pages, and includes papers read before the society during the period December 8, 1904, to November 9, 1905. As the papers read at meetings of the society are briefly described in our "Societies and Academies" columns, there is no necessity for a detailed statement of the contents of the volume, though it may be added that, in addition to the papers, the volume includes records of the proceedings at meetings and an obituary notice of the late Mr. Robert Tucker by Prof. M. J. M. Hill, F.R.S.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c* (GIACOBINI).—Herr A. Wedemeyer gives a continuation of his daily ephemeris for comet 1905*c* in No. 4074 of the *Astronomische Nachrichten*. The following is an extract therefrom:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Feb 18	0 49 32	−13 26	9·9192	0·1123	2·91
20	1 2 3	−11 55	9·9424	0·1237	2·48
22	1 13 48	−10 27	9·9640	0·1355	2·13
24	1 24 45	− 9 2	9·9843	0·1477	1·83
26	1 35 0	− 7 41	0·0034	0·1602	1·58
28	1 44 37	− 6 24	0·0214	0·1728	1·38

Brightness at time of discovery = 1·0.

It will be noticed that the comet has rapidly decreased in brightness, and, as its magnitude when discovered was only about 10·0, has become a more difficult object. On February 18 it will set about $2\frac{1}{2}$ hours after sunset in the south-west.

COMET 1906*a* (BROOKS).—Several observations of comet 1906*a* are recorded in No. 4073 of the *Astronomische Nachrichten*, in which also appear a set of elements and an ephemeris calculated by Herr M. Ebell.

The magnitude of the comet on January 28–31 was about 10·0, and Prof. Hartwig, observing with the Bamberg heliometer on the latter date, recorded that the comet was round, had no tail, and had a central nucleus which appeared to be about one magnitude fainter than a 9·3 magnitude star.

The latter part of Herr Ebell's ephemeris is given below:—

12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true)	log *r*	log Δ	Brightness
Feb. 16	12 4 44	+84 35	0·1909	9·9742	0·99
17	10 35 41	+84 48			
18	9 13 22	+84 15	0·1955	9·9817	0·94
19	8 12 51	+83 8			
20	7 32 10	+81 43	0·2001	9·9912	0·88

Although near to the pole, the comet is not an easy object, owing to its small magnitude, which is now decreasing.

OBSERVATIONS OF EROS.—The results of a number of observations of Eros, made at the Arcetri Observatory between July 26 and August 25, 1905, appear in No. 4073 of the *Astronomische Nachrichten*.

Variations in the magnitude of the asteroid were observed as follows:—July 28, mag. = 11·4; August 7, mag. = 10·9; August 23, mag. = 12·0.

Comets 1905*b* and 1905*c* were also observed at Arcetri, and the results are given in the same journal.

CATALOGUE OF STARS WITHIN TWO DEGREES OF THE NORTH POLE.—Publication No. 2 of the Vassar College Observatory is devoted to a catalogue of 408 stars all of which are within 2° of the North Pole. The coordinates and magnitudes have been determined from eight plates taken by Prof. Donner, of the Helsingfors (Finland) Observatory, by Dr. Caroline E. Furness. A previous publication (No. 1) dealt similarly with the stars situated within 1° of the pole, and to this the present volume forms a sequel. The positions are given for 1888·0, and in cases where the star is common to both, references are given to the B.D.M. and Carrington catalogues. The present work is published by the Carnegie Institution, and forms No. 45 in the publications of that body.

THE FIRE NEAR MOUNT WILSON OBSERVATORY.—Writing to *Popular Astronomy*, No. 2, vol. xiv., Prof. Hale corrects the recent report concerning the forest fire on Mount Lowe, and states that, as the fire did not come within several miles of the Solar Observatory, the observers there were never in any fear that the buildings or instruments might be injured.

THE INCREASING PERIOD OF β LYRÆ.—In an article published in No. 367 of the *Observatory*, Dr. Alex. W. Roberts makes an interesting suggestion concerning the diminishing rate of increase in the period of β Lyræ.

Having discussed a number of previous observations, he has deduced a formula which gives the period of this variable at any date, the epoch being 1900·0. The suggested cause is that in β Lyræ we have a binary in which the component stars are slowly receding from each other under tidal forces, and if this is so it provides direct evidence in support of Prof. Darwin's theory regarding the evolution of planetary and stellar systems.

THE UNITED STATES NAVAL OBSERVATORY.—Rear-Admiral Chester's report of the operations of the United States Naval Observatory for the fiscal year ending June 30, 1905, shows that the staff is again to be congratulated on the amount of work performed. Nearly 950 observations, including 218 of Saturn's satellites, were made with the equatorial, and 9179 observations were made with the meridian instruments; the latter included nearly 4000 observations of Gill's "zodiacal stars" and an equal number of "standard stars."

The A.G. Zone Catalogue of the stars between −13° 50′ and −18° 10′ is nearing completion; all the stars have been observed, and most of the observations have been reduced to 1900·0.

With the photoheliograph, photographs of the sun were obtained on 166 days, and showed spots and faculæ on the solar disc on 162 days. Whilst engaged upon this work, Mr. G. H. Peters made some valuable observations regarding the focal variation due to temperature. A new triple lens of $7\frac{1}{2}$ inches aperture and 65 feet focal length, giving a solar image of about 7 inches diameter, has been procured, and was to be used for solar photography after its employment on the 1905 eclipse expedition to Spain.

The branch observatory at Tutuila, Samoa, was, on the date of the report, rapidly approaching completion.

RECENT REPORTS OF GEOLOGICAL SURVEYS.[1]

Cleavage.

THE subject of rock cleavage is one of perennial interest; only a short time ago were Dr. Becker's views noticed in these columns, views founded upon experiment and analysis. Now, Dr. Leith (1) lays before us his reading of the same problems after attacking them by the way of micro-sections and field observations. The author makes the term "rock cleavage" very comprehensive; he recognises among cleavable rocks two broad divisions, which he calls respectively protoclase, or original cleavage rock, and metaclase, or secondary cleavage rock. The former class includes such structures as bedding in sediments and flow structure in lavas; the latter class is considered under the heads "fracture cleavage" and "flow cleavage." Fracture cleavage is conditioned by the existence of incipient or cemented and welded parallel fractures, and is independent of the parallel arrangement of the mineral constituents. Flow cleavage is conditioned solely by a parallel arrangement of the minerals. The one is a phenomenon of the zone of fracture, the other of the zone of flowage in the lithosphere. Fracture cleavage is made to include, wholly or in part, those structures that have been variously described as close-joint-cleavage, false

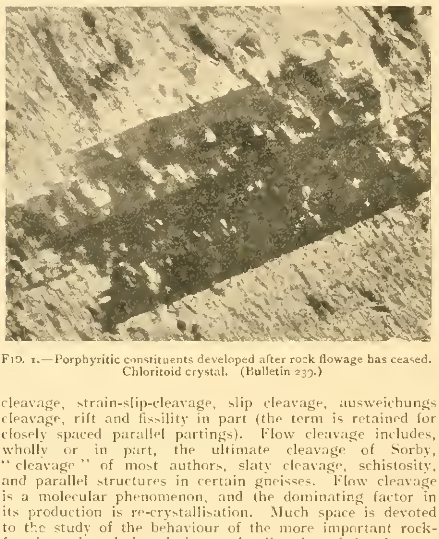


FIG. 1.—Porphyritic constituents developed after rock flowage has ceased. Chloritoid crystal. (Bulletin 239.)

cleavage, strain-slip-cleavage, slip cleavage, ausweichungs cleavage, rift and fissility in part (the term is retained for closely spaced parallel partings). Flow cleavage includes, wholly or in part, the ultimate cleavage of Sorby, "cleavage" of most authors, slaty cleavage, schistosity, and parallel structures in certain gneisses. Flow cleavage is a molecular phenomenon, and the dominating factor in its production is re-crystallisation. Much space is devoted to the study of the behaviour of the more important rock-forming minerals in relation to the direction of the cleavage in rocks, and many thin slices have been examined to determine how far there existed a parallelism between the cleavage of the rock and dimensional and vector properties of given mineral species.

The bulletin is evidently the result of a great deal of work, and contains a clear statement of the author's views; the illustrations are excellent, and it must be read by all interested in the subject, but it cannot be said greatly to advance our knowledge.

The Geology of Cements.

Several reports have appeared from time to time dealing with the raw cement materials of individual States; in Bulletin No. 243, E. C. Eckel (2) summarises the available information for the United States as a whole. "The object has been to treat the subject from the geological rather than from the technical standpoint, although the technology of the cement manufacture is also discussed with sufficient fulness for the purpose of the report." While mainly a compilation, and bearing the impress of composite authorship, there is in this volume an air of freshness about the facts and of uniformity about their presentation which is doubtless due to the circumstance that Mr. Eckel personally visited every district in which cement is being produced, and examined nearly every plant in operation. Nor were the undeveloped deposits of cement material neglected.

The bulk of the report is devoted to Portland cement materials in the several States; the geological characters and relationships of the limestones, clays, and natural cement rock are clearly explained, abundant analyses are shown, and the peculiar local conditions of transport and fuel, as well as the available markets, are briefly discussed. The cement materials are derived from rocks of the most diverse geological age, ranging from Cambrian up to recent marls and alluvial silts. Short sections are given to the "natural" cement resources and to the Puzzolan cements. We noticed in the section on the grinding of raw materials no reference to the influence of the degree of fineness upon the temperature required for a suitable clinker.

General Geology.

The average British geologist, if his range of vision is not quite limited by the importance of the exposure in his own back garden, if he can momentarily turn from pebble-picking and the unravelling of zones, may enjoy by following Prof. Russell across central Oregon, a pleasant and profitable, if somewhat tantalising, hour. The region included in this preliminary report (3) comprises the country between the Snake River on the east and the Cascade Range on the west, and thus takes in the extreme northern part of the Great Basin.

The predominant rocks of central Oregon are volcanic; an older series of rhyolites and andesites is succeeded by a younger series of basaltic rocks, which are again followed in the Pauline Lake district by andesitic outbursts. The oldest of the rocks dates from early Tertiary times; the youngest may be only a few centuries old.

The sedimentary rocks are represented by soft clays, sands and volcanic dust of Tertiary age. The most conspicuous elevations in central Oregon are of volcanic origin; many are old worn-down craters and peaks, but young volcanoes, particularly as the Cascades are approached, are exceedingly abundant. "Their cones, so recent in numerous instances that erosion has not yet broken their crater rims, are so numerous that 50 or more may frequently be counted in a single view, while a change of a few miles in the position of the observer brings perhaps as many more within the range of vision."

Many interesting features in the water supply and drainage of the country are described in these pages, but none exceeds in interest the fascinating story of the Deschutes River, about the point where it is joined by its tributary the Crooked River. First we find that the Deschutes in Tertiary times had eroded a great valley twenty to thirty miles wide in parts; then most of this valley was filled to a depth of more than 700 feet by water-borne volcanic dust and lapilli with a little sand and clay; this was followed by a sheet of basalt some 80 feet thick. Displaced in this way from their old courses, the Deschutes and its tributaries cut fresh channels and made canyons in the new material 800 feet deep and about one mile wide, until

[1] (1) Bulletin 239, 1905, "Rock Cleavage." By C. K. Leith.
(2) Bulletin 243, 1905, "Cement Materials and Industry." By E. C. Eckel.
(3) Bulletin 252, 1905, "Preliminary Report on the Geology and Water Resources of Central Oregon." By I. C. Russell.
(4) Bulletin 235, 1904, "A Geological Reconnaissance across the Cascade Range." By G. O. Smith and F. C. Calkins.
(5) Bulletin 242, 1904, "Geology of the Hudson Valley between the Hoosic and the Kinderhook." By T. N. Dale.
(6) Bulletin 254, 1904, "Report of Progress in the Geological Re-survey of the Cripple Creek District, Colorado." By Waldemar Lindgren and F. L. Ransome.
(7) Bulletin 237, 1905, "Petrography and Geology of the Igneous Rocks of the Highwood Mountains, Montana." By L. V. Pirsson.
(8) Twenty-fifth Annual Report of the U.S. Geological Survey, 1903–4.
(9) Indiana, Department of Geology and Natural Resources, Twenty-ninth Annual Report, 1904. By W. S. Blatchley.
(10) Canada: Summary Report of the Geological Survey Department of Canada for the Calendar year 1904 (1905).

once more an outburst of basaltic lava filled up the canyons to a depth of at least 500 feet. Still in their old courses, but displaced from their channels, the streams had again to commence re-excavation. At the present time they have cut through more than 500 feet of the hard basalt without reaching its bottom. The two periods of canyon cutting probably belong to the "Sierran" epoch of Le Conte.

Hot springs, desert conditions, glaciation, and the influence of domestic animals upon river erosion form the subjects of notes. The illustrations are beautiful, and helpful to the text.

FIG. 2.—View of double-crested moraine on south-side of Hayden Glacier, looking west. (Bulletin 252.)

The region about the northern limit of the Cascade Range was traversed by Messrs. G. O. Smith and F. C. Calkins (4) in a rapid reconnaissance. The older rocks encountered are grouped together as pre-Cretaceous, comprising (1) old-looking schists along the Columbia River and lower Okanogan Valley; (2) supposed Carboniferous sediments with volcanics in the more northern part of the Okanogan Valley; (3) strata similar to the last mentioned exposed in the base of the upper Skagit River; (4) some old sediments and a great volcanic mass near Hamilton; and (5) a great assemblage of strata ranging from Palæozoic to Jurassic lying to the west and north of Mt. Baker.

An extensive development of the Cretaceous is indicated from the Hozomeen Range on the west to the Similkameen Range on the east; the name "Pasayten formation" is proposed for this in place of Prof. Russell's term Similkameen. Sandstones and shales predominate; contemporaneous igneous rocks appear to be absent. Tertiary sediments occupy a much smaller area than do the Cretaceous, but volcanic rocks, presumably of this age, are of some importance. Later formations are represented by glacial and river gravels, and by the andesitic lavas of Mt. Baker.

As compared with their immense importance in the southern Cascades, the part played by volcanic rocks in the boundary section appears very subordinate. Plutonic rocks are greatly developed, the prevailing type being a "grano-diorite." The volcanic rocks range from soda-rhyolite, dacite, acid and basic andesites, to basalt. The dyke rocks include a soda-syenite from south of Bighorn Peak, and a diorite (?) in which apatite occurs in broad, irregular plates as one of the last products of crystallisation. The authors conclude that volcanic and plutonic rocks alike may have been derived from a homogeneous magma, low in alkalies, with soda predominating over potash; hence they may belong to the same province as the rocks of the southern Cascades and the Sierra Nevada.

Dr. Dale has written a short account of the stratigraphy of a strip of the Hudson Valley (5) between the Hudson River on the west and the Rensselaer Plateau and the Taconic Range on the east. The difficulties in the way of delimiting the age and relations of the several formations are the rarity and bad preservation of the fossils, the repeated minor overfolding, and the prevalence of Glacial drift. An excellent map accompanies the paper on the scale of 1 inch to the mile; fossil localities and good outcrops are clearly indicated by a system of coloured spots—a plan worthy of imitation.

The formations represented are Lower Cambrian, Beekmantown shale with Dictyonema and Clonagraptus, the Hudson shale and Hudson schist (Ordovician = Trenton), and the Silurian Rensselaer Grit = Oneida, Medina.

Three crustal movements are recognised in the area:—(*a*) at the close of the Lower Cambrian, Upper and Middle Cambrian are missing; (*b*) the Taconic or Green Mountain movement which folded the Ordovician beds; (*c*) a post-Devonian or Carboniferous movement which folded the Silurian Grit of the Rensselaer Plateau. Minor oscillations are indicated by conglomerates which occur in the Lower Cambrian, in the Hudson shale, and in the Rensselaer Grit.

Although only ten years had elapsed since Cross and Penrose made a careful study of the Cripple Creek district, the people of Colorado asked for a re-survey on account of the great development of underground working in the interval; this re-survey has been undertaken by Messrs. Lindgren and Ransome, who have now issued a report of progress (6) in advance of the laboratory examinations.

FIG. 3.—View in Opal Canyon, Crooked River, Crook County, showing basalt of inner canyon in contact with stratified beds of outer canyon. (Bulletin 252.)

The oldest rocks in the district are the muscovite and fibrolite schists; these are closely associated with fine-grained granitic gneiss. Both gneiss and schist are cut by a reddish granite. A second type of granite is the coarsely porphyritic Pikes Peak type. As a result of the recent work, the views of Cross upon the rocks erupted

from the Cripple Creek volcanic centre are somewhat modified; the various rock types recognised by him are shown to be linked by intermediate forms; they are clearly all divergent eruptive facies of one general magma, characterised by containing from 9 per cent. to 15 per cent. of potash and soda, the soda being always somewhat higher than the potash; no true andesite is recognised. Most of the ore has come from the central area of phonolitic breccia.

The bulk of the telluride ore-bodies is in fissure veins, either simple or complex, being closely spaced and linked together, constituting what is called a "sheeted zone." The fissures radiate from a point to the north of the area; they are uniformly narrow, therefore the amount of gangue and ore is comparatively small. Quartz, fluorspar, and other minerals usually line the walls of the fissures; the rich tellurides are generally the last minerals to form. The authors consider that the unoxidised ore deposits represent the product of one period of general mineralisation not appreciably modified by any secondary enrichment. The last exhalation of the Cripple Creek volcano seems to be a mixture of nitrogen with about 20 per cent. of carbon dioxide and a small amount of oxygen. The gas increases in quantity with the depth, and in some cases interferes seriously with mining operations.

An interesting description of the petrography of the Highwood Mountains of Montana (7) is given by Prof. Pirsson. This region is occupied by a greatly eroded group of volcanoes which were in activity at some time subsequent to the Lower Cretaceous; several necks (stocks) are exposed, and now stand up as prominent peaks. Highwood Peak, the highest point in the group, is composed of syenite (pulaskose) and monzonite (shoshonose); in East Peak the rock is a basic leucite syenite. The Shonkin stock is shown to consist of Missourite, passing by intermediate stages into shonkinite. The Arnoux stock is important as the source of a new variety, *Fergusite* (fergusose), a rather coarse-grained, pseudo-leucitic augite rock, consisting of orthoclase, nepheline, and diopside; it appears to bear a similar relation to the leucitites that missourite does to the leucite basalts. In describing the petrographic characters of the necks, dykes, and extrusive flows, the new nomenclature is used concurrently with the old, so that the conservative reader need not be dismayed by "Trachyphyro-Highwoodose," "grano-shoshonose," or what not. The author concludes with some suggestive remarks on magmatic differentiation.

The annual report of the United States Geological Survey (8) is, as usual, a record of excellent organisation and of abundant energy in all departments.

The twenty-ninth annual report on the geology and natural resources of Indiana (9) contains a monograph of some 650 pages, by Prof. Blatchley, on the clays and clay industries of the State, the reports of the inspectors of mines and natural gas, a paper on the utilisation of convict labour in making road material, an account of the petroleum industry in Indiana in 1904, and a paper on the insect galls of Indiana.

The section on clays is very much like similar reports with which we are becoming daily more familiar; it is an excellent report of its kind. It describes in detail the clay resources of each county, with geological information and analyses; suggestions are given as to available clays and shales that are as yet unworked, and advice is given as to the best way of dealing with them. The use of bricks for road-making is strongly advocated, and the full specifications for the construction of brick pavements in the city of Terre Haute are given; these may prove of interest to those in this country who favour this type of road—the brick roads in Terre Haute have given great satisfaction. The report is illustrated with photographs and maps, and with full statistics of the various branches of the clay industry.

The paper on insect galls, by Dr. Cook, is little more than a catalogue of the galls known in the State. It is provided with a simple introduction to the subject and a bibliography, and with numerous outline sketches and photographs. It should be appreciated in the State. We are not aware that the papers mentioned above are issued separately; if this is not the case it seems unfortunate, for they appeal to such divergent interests.

The summary report of the Geological Survey of Canada (10) for 1904 indicates considerable activity in all quarters of the Dominion. A striking illustration of the usefulness of the survey lies in the discovery of a coal seam 10 feet thick in a bore-hole 2340 feet deep in Cumberland, Nova Scotia. This bore-hole was sunk through a thick cover of unproductive rocks at the suggestion of Mr. Hugh Fletcher, of the Geological Survey staff, after he had worked out the structural geology of the district.

In the Purcell Range, Dr. Daly records an enormous sill of hornblende-gabbro, 2500 feet thick; this he calls the "Moyie sill," from its occurrence at a point where the Moyie River crosses the international boundary. This great mass of basic rock has been thrust into the pre-Cambrian Kitchener quartzite, with the result that its upper portion, some 200 feet thick, has been converted into an acid biotite-granite by assimilation of the siliceous sediment. This has come about principally through the agency of "gravitational differentiation" following the shattering of the quartzite by the heated contact.

Prospecting for iron by means of the magnetometer (Thalen-Tiberg form), an innovation in Canada, seems to have had good results in Charlotte County, New Brunswick. Dr. Barlow contributes some notes on the occurrence of corundum in the intrusive complex of Robillard Mountain at Craigmont. The corundiferous rocks are of syenitic or gabbroid type; scapolite and nepheline often accompany or replace the prevailing felspars. Some of the syenite contains as much as 34 per cent. of corundum.

J. A. H.

THE PERIODICITIES OF SUN-SPOTS.[1]

EVERYBODY knows how to interpret the curve by means of which the intensity of radiation of a body is expressed in terms of the wave-length or frequency, and everybody recognises the utility of such a curve. It allows us at once to distinguish between the line spectrum and the spectrum of bands or the continuous spectrum, and brings out regularities which would be difficult to recognise in the original disturbance. In practice we employ the spectroscope to give us the data from which the curve of intensities is constructed. But what the spectroscope can do for a luminous disturbance, calculation can do for any quantity which fluctuates about a mean value. We are able, therefore, to construct in every case a curve which in all respects is analogous to the graph which connects the period and intensity of radiation. This curve I call the periodograph, and refer to the diagram embodying the curve as the periodogram. There is a periodogram of rainfall or barometric change, and these curves would, in my opinion, if constructed for different localities, yield us most important and characteristic information about climate.

During the last three years I have been occupied in calculating the periodogram of sun-spot variability. The results have been communicated to the Royal Society, and the following is a summary of abstracts which are published in the *Proceedings* of that society. The first paper deals with a detailed examination proving that the process I employ furnishes an analysis which is identical with the experimental spectrum analysis supplied by the grating. In the second paper the method is applied to the statistics of sun-spots.

The data used were Wolf and Wolfer's sun-spot numbers, which give us sufficient information from the year 1749 to the present time. I have in addition used, wherever possible, the measurements of areas which for each synodic revolution of the sun have been collected by the Solar Physics Committee of the British Board of Education from the year 1832 onwards, and the areas measured from photographs at the Greenwich Observatory for each day of the year since January 1, 1883.

The whole of the observations were treated collectively, but the complete interval of 150 years was also divided into two nearly equal portions, which were separately examined. At first sight, the results obtained by a com-

[1] Abstract of two papers, entitled, (1) "The Periodogram and its Optical Applications"; (2) "The Periodicity of Sun-spots." Read before the Royal Society on December 7, 1905.

parison of the two intervals of 75 years were exceedingly puzzling. While the observations beginning with about 1826 showed a nearly homogeneous variation of 11·125 years, this period seemed almost entirely absent between 1749 and 1826. Its place was during that interval taken by two important groups of periodicities, one of which had a periodic time of about 9·25 years, while the second had an average period of 13·75 years. The latter period was represented more nearly by what in spectroscopy is called a "band," extending from 13·25 to 14·25 years, but some of this want of definiteness may be due to the deficiency in observational data. For some time I was inclined to draw the conclusion that such periodicities as we observe are comparatively short lived, and replaced by a number of others which in their turn die out. A more detailed investigation, however, convinced me that the periodicities are, as regards the interval of time elapsing between successive maxima, extremely regular, occurring with what may prove to be astronomical accuracy. The key of the solution is, I believe, to be found in the overlapping of a number of periods, all of which are regular as regards time, but vary considerably as regards intensity, so that one or other may for a certain number of years become inactive. Their real existence is proved by the fact that whenever they reappear after a period of inactivity, the phase of the renewed periodic action fits in exactly with the continuation of the old period.

A periodicity of about 4·78 years runs through the whole of the observations. Its amplitude being about one-sixth of that of the eleven-year period is too great to be accounted for by accident. It appears separately in the series of Wolf's numbers, ranging from 1749–1826 and from 1826–1900. It also appears in the series depending on the measurement of areas. The phases of the period as determined from these series are in good agreement, and even while I was inclined to question the permanency of the eleven-year period I never felt any doubt that during the whole length of 150 years this period has been acting. Its time, determined as accurately as possible from the combined records, was 4·81 years, but I believe that if greater weight were given to the more recent and more complete observations the number would be slightly reduced. As regards the main period, which has certainly given its character to the sun-spot statistics during the greater part of the last century, I find the time as determined from the observations since 1826 alone to be 11·125 years. This agrees well with Wolfer's estimate of 11·124, and Newcomb's investigation, which led to 11·13 as the most probable number.

If to the most accurate series of measurements of sunspot areas which begin in 1832 we apply a process the result of which is the elimination of the chief period, and draw a curve representing what is left, we find decided maxima during the years 1836, 1845, 1853, 1862, and 1870, the intervals being alternately 9 and 8 years, or 8·5 years on the average. The periodogram based on Wolf's numbers for the complete interval 1749–1900 shows a decided maximum of intensity for a periodicity of 8·25 years. Adopting this period provisionally, and disregarding all observations since 1826, we may use Wolf's series previous to that date for the determination of the phase of the period in question, and thus forecast the maxima for the subsequent interval. We thus obtain 1836·3, 1844·7, 1852·9, 1861·2, 1869·4, in almost exact agreement with the above. The slight disagreement of phase would be corrected by assuming the time to have been 8·32 years.

A periodicity of about 13·5 years shows as a maximum of intensity in the periodogram for the complete interval. In connection with it the following facts seem remarkable. There are in Wolf's records three cases of successive maxima having an interval of between 13 and 14 years. They are:—1626·0–1639·5, 1816·4–1829·9, 1870·6–1883·9. Also the interval between 1639·5 and 1816·4 is thirteen times 13·61, and the interval between 1829·9 and 1870·6 is three times 13·57. Thus the maxima all fit in with a period of about 13·6 years, which with varying intensity seems to have run through the whole record of observations.

Not wishing to lay too great a stress on what may prove to be merely a numerical coincidence, I return to the three periods which have been determined with some accuracy. It was only after the periodic times had been independently determined that the following remarkable relationship between the numbers was discovered. Taking frequencies into consideration, we are led to form the reciprocals of the periodic times, and thus find

$$1/11{\cdot}125 = 0{\cdot}08989$$
$$1/8{\cdot}32 = 0{\cdot}12019.$$

Adding up we find

$$1/4{\cdot}76 = 0{\cdot}21008.$$

Hence the sum of the frequencies of two of the periods agrees within the possible errors with the frequency of the third period. But it is also found that the two first numbers are very nearly in the ratio of three to four, so that we may also express the three periodic times as subperiods of 33·375 years. Thus

$$\tfrac{1}{3} \times 33{\cdot}375 = 11{\cdot}125$$
$$\tfrac{1}{4} \times 33{\cdot}375 = 8{\cdot}344$$
$$\tfrac{1}{7} \times 33{\cdot}375 = 4{\cdot}768.$$

How far this connection is accurate or approximate it is impossible to say at present, but the fact that the three periods which have been traced with a considerable degree of certainty should also bear a remarkably simple relationship to each other is worthy of note.

If we accept a period twice as long as that given above, we might account for other periodicities of which at present the times are only approximately determined; thus $\frac{1}{5} \times 66{\cdot}75$ would lead us to 13·34, in fair agreement with the period of 13·57 years which has been mentioned above. But the difference is greater than it should be, and at the present I do not wish to put forward the longer.

ARTHUR SCHUSTER.

NATURAL HISTORY AND ARCHÆOLOGY OF THE WATERLILIES.[1]

MR. CONARD has embodied the result of several years' work on the waterlilies in the sumptuous volume before us. The monograph opens with an historical account of the plants as they were known to the ancients, and then deals with the group from a modern botanical point of view.

An interesting part of the memoir deals with the morphology and development of the plants, and the reader will find much that is worth reading therein. It must be confessed, however, that, taken as a whole, this portion occupies a somewhat large number of pages in proportion to the amount of valuable information it contains. The structure of the root is given at some length, but one would have liked to see a comparative treatment given that embraced not only the roots of different species, but also those of an individual plant at various stages of the life-history. Possibly such an investigation might throw light on the nature or origin of the "Liorrhizic" character of the roots in the waterlilies. Mr. Conard gives a good account of the formation of the intercellular spaces and the diaphragms so characteristic of the order, and he mentions an interesting occurrence of stomata on the under surface of the aërial leaves that rise above the level of the water in *Nymphaea odorata* var. *minor*.

The occurrence of stipules is a point of some note, and it may be remarked that their absence from the early leaves of the seedlings detracts from their phylogenetic significance in the group.

A short sketch of the development of the flower is included in the monograph, and we think it might have been considerably extended with no small advantage. The flowers, as is well known, occupy a remarkable position in waterlilies, where they apparently replace a leaf. The author was led to adopt a suggestion made by Caspary as to the morphology of the flower which explains the anomaly and at the same time appears to fit the facts of development. The anterior sepal, which appears first, and often well below the others, is regarded as morphologically representing the bract, whilst the two lateral sepals are

1 "The Waterlilies. A Monograph of the Genus Nymphæa." By Henry S. Conard. Pp. xiii+279. (Published by the Carnegie Institution of Washington, 1905.)

in like manner formed at the expense of the two prophylls. A similar explanation, it may be remarked, has been advanced, also on good grounds, to explain the otherwise anomalous character of the flower and inflorescence in *Adoxa moschatellina*.

The chief part of the work is devoted to the taxonomy of the group and to the description and delineation of the different species. Distribution and hybridisation are briefly considered, and a short chapter on the culture of the waterlilies is added; the work closes with an excellent bibliography.

The illustrations are numerous, and many of them are finely executed in colour, whilst the paper and printing leave nothing to be desired even by the most fastidious bibliophile. The book certainly deserves a place on the shelves of those who are interested in a group more beautiful than most, and perhaps inferior to none, of the plants that are cultivated for the beauty alike of their form and of their colour.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The general board has nominated the following as electors to professorships:—Prof. W. A. Tilden to the professorship of chemistry, Sir W. D. Niven to the Plumian professorship of astronomy, Sir A. Geikie to the professorship of geology, Prof. J. J. Thomson to the Jacksonian professorship of natural philosophy, Sir W. H. Broadbent to the Downing professorship of medicine, Dr. L. Fletcher to the professorship of mineralogy, Prof. Larmor to the professorship of experimental physics, Sir W. H. White to the professorship of mechanism and applied mechanics, Prof. Schafer to the professorship of physiology, and Dr. J. F. Payne to the professorship of pathology.

Mr. A. R. Brown, of Trinity College, has been elected to the Anthony Wilkin studentship in ethnology and archæology. This is the first election which has been made to this recently founded studentship.

THE Goldsmiths' Company has voted a further sum of 1558*l*., in addition to its previous endowment of the Goldsmiths' College at New Cross, to defray the expenses of putting the buildings in complete working order.

UNDER the auspices of the Society for the Technical Education of Women, founded a few years ago by Mrs. P. N. Arian, a technical high school for women was opened in St. Petersburg on January 28. The new high school has two faculties, one for engineering and building subjects, and the other for electrochemistry, and provides a four-year course in each, which courses it is intended shall be of the same educational standard as those in the same subjects in the present technical high schools.

WE have received a copy of a well illustrated "Souvenir" of the opening last year of the new engineering and metallurgical laboratories of the University of Sheffield. In view of the illustrated article published in NATURE for July 20, 1905, describing the new buildings at Sheffield, it is unnecessary to do more than direct attention to the excellence and great extent of the provision made in this new university for teaching the higher branches of applied science. It is possible from the numerous well executed pictures in the souvenir to form a good idea of the laboratories and their equipment without a visit to Sheffield.

Science announces further munificent gifts to higher education in the United States. Mr. John D. Rockefeller has given 290,000*l*. to the University of Chicago. Of this sum, 200,000*l*. is for the permanent endowment, 70,000*l*. to cover the current expenditures or deficit of the various departments of the University to July 1, 1907, and the remaining 20,000*l*. is to provide a fund, the interest of which is to go to the widow of the late President Harper during her lifetime. By the will of the late Mr. Marshall Field, Chicago receives 1,600,000*l*. for the endowment and maintenance of the Field Columbian Museum. The bequest is on condition that within six years from the death of Mr. Field there shall be provided a satisfactory site for the permanent home of the museum. By the will of the late Mr. W. C. Putnam, the Davenport (Iowa) Academy of Sciences becomes prospectively one of the most richly endowed institutions of its kind in the world. Mr. Putnam left an estate of 140,000*l*. with provisions for limited incomes to relatives, the remainder of the revenues to be paid to the academy, and the entire estate to go to that institution at the death of the surviving brothers and sisters.

UNDER the leadership of Dr. Chiari, a member of the Austrian Government, a petition was recently laid before the Austrian Minister of Education in which the teaching of chemistry in the technical high schools was given the most prominent place. The petition affirmed that the present conditions of the chemical laboratories in the high schools had repeatedly been the subject of severe criticism in technical circles; that neither the space provided, the existing equipment nor the teaching staff was at all adequate to the requirements of modern chemistry. The backwardness of Austrian chemical laboratories could not but most seriously affect the chemical industries; indeed, in no other branch of commerce was a direct and intimate connection with the high schools so absolutely essential. The schools had been neglected, and consequently it was found that instruction in general technical chemistry and the intensive study of those branches of technical chemistry which were particularly suited to Austria had not received that amount of attention which they needed. A scheme involving the erection of a new chemical institute in Vienna was laid before the Government last year. The petitioners desired a speedy settlement of the existing misunderstandings on this subject, as they considered the building of such a chemical institute the first condition to an increased interest in Austrian chemical industries.

A copy of the address delivered by Sir Alexander R. Binnie at the recent distribution of prizes to students of the Merchant Venturers' Technical College, Bristol, has been received. The address dealt in broad outline with education and with what it in a certain sense implies, the acquisition of knowledge. Answering the question, How do we obtain knowledge? Sir Alexander Binnie said it can only be obtained through those senses with which human beings are endowed. First, knowledge includes sensations directly conveyed, that is, personal knowledge. Then there is knowledge of the world conveyed in books, that is, the teaching of authority; and there is a third, an all important division of knowledge, derived partly through observation, and partly through the mysterious property called mind. Observation and reasoning lead, especially in the line of science, to certainties greater, often more sure and more truthful, than those received through the senses. Later in the address Sir Alexander Binnie urged that in all these matters of education it is necessary to be careful; arrogance and self-conceit are quite out of place. There are limitations to all, but in the study of nature, and the great truths that nature reveals, the human mind is enlarged and its conceptions are elevated. In all the knowledge acquired during the years that human beings are permitted to indulge in that wonderful spectacle which nature presents, a preparation is being undergone, and it is to be hoped an advancement from a lower to a higher grade of mind.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"The Determination of the Osmotic Pressures of Solutions by the Measurement of their Vapour Pressures." By the Earl of **Berkeley** and E. G. J. **Hartley**. Communicated by W. C. D. Whetham, F.R.S.

The authors find that Ostwald and Walker's "bubbling" method of determining the lowering of the vapour pressure of solutions is unsatisfactory. They therefore use a form of apparatus such that dry air is allowed to pass over the solution, while the latter is continuously stirred, and then over the solvent. By placing two vessels containing

the solution in series, the constancy of weight of the second vessel indicates that the air has been saturated up to the vapour pressure of the solution. The total quantity of vapour given off by the solution and solvent is absorbed by sulphuric acid, and the gain in weight of the latter should equal the loss sustained by the two former. With solutions in water, it is pointed out that, on account of the condensation of solvent in the tube leading to the sulphuric acid, this never quite obtains. The loss of weight of the solution in conjunction with that of the solvent give, however, the data for calculating the osmotic pressure. It is shown that Arrhenius's formula, when applied to concentrated solutions, does not connect the true osmotic pressure with the lowering of vapour pressure; and a more correct relation is deduced from a consideration of the hydrostatic pressures about a column of solution which is closed at the lower end by a semi-permeable membrane, and is partially immersed in the solvent. It is found that the osmotic pressures of cane-sugar solutions when calculated by way of vapour pressures and when observed directly agree to within 5 per cent. of one another over a range of 20 to 110 atmospheres.

January 25.—"Artificial Double Refraction, due to Æolotropic Distribution, with Application to Colloidal Solutions and Magnetic Fields." By Dr. T. H. **Havelock.** Communicated by Prof. J. Larmor, Sec.R.S.

The sections of the paper are summarised as follows:—

(1) The formal investigation of artificial double refraction in colloidal solutions as due to a deformation of the medium consisting of a change in the packing of the colloidal particles.

(2) The possibility that such deformation may be produced by mechanical stress as arising from the possession of a certain amount of rigidity by such solutions.

(3) The analogy between the effects so produced and the double refraction due to a magnetic field.

Linnean Society, January 18.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Coloured transparencies from flowers in natural colours: T. E. **Waltham.**—The life-history of *Margaritifera Panasesae*: A. W. **Allen.** The paper was interesting as the result of close observation in the field, though practically all had been observed by other observers in various parts of the world, and of various nationalities.—Some endophytic algæ: A. D. **Cotton.** The observations referred chiefly to *Endoderma viride*, Lagerh., which occurs abundantly in the tissues of *Nitophyllum Hilliae*, Grev., a deep-water alga, only obtainable by dredging. The author also gave the result of his study of *Streblonema intestinum*, Holmes and Batters, based upon Reinsch's preparations in the Kew herbarium.—The organ of Jacobson in Sphenodon: Dr. A. **Broom.**

February 1.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The Percy Sladen Trust Expedition in H.M.S. *Sealark* to the Indian Ocean: J. Stanley **Gardiner.** Accounts of the work and results of the expedition were given by Mr. Gardiner in Nature of April 13, August 10, October 5, November 9, December 21, 1905, and January 25 of the present year.

Anthropological Institute, January 23.—Prof. W. Gowland, president, in the chair.—Annual meeting.—Annual address: copper and its alloys in antiquity: **President.** Smelting had its origin in the camp fire, from which the first primitive furnace, a hole in the ground, used even now in parts of Japan, naturally evolved. The lumps of copper discovered in "founders' hoards" had clearly been smelted in this way. The hole was first filled with charcoal, over which was placed the ore, then another layer of charcoal, then more ore, and so on; the draught was obtained by the wind or by primitive bellows. The smelted copper was not run off, but, at the moment of solidification, was pulled out of the fire and broken into pieces on a large stone. This system is still practised in Korea, while the implements used by primitive man have their counterpart at the present day in the tools used by the native smelters in some parts of Africa. Turning to the question of bronze, Prof. Gowland stated that in his opinion this was made directly from a copper ore containing tin, long before the two metals were mixed. In Hungary a copper ore containing antimony takes the place of a copper-tin ore, and the implements found there frequently contain antimony in considerable amounts. He defined bronze as an alloy of copper and tin containing not less than 2 per cent. of tin; lead, arsenic, zinc, &c., being present in very small quantities. The president was of opinion that there was no evidence of a true Copper age in Europe, excluding only Cyprus, which was, of course, exceptional. Copper implements were only used by primitive man as adjuncts to stone implements, which were more efficient as weapons, and when found are only copies of stone implements, or when made in the Bronze age take the form of the implements of that period. In its simple form a copper celt could only be made in an open mould, and therefore only flat celts could be made of copper. The opinion often maintained, that the intention of the makers of bronze weapons was to make an implement in the proportion of 9 : 1, was shown by analysis to be incorrect, as also was the theory that the art of tempering bronze was lost, as it could now be hardened by hammering as well as, if not better than, it was done in the Bronze age. The lecturer also clearly proved that metallic tin was not necessary to the manufacture of bronze, and bronze celts made by him by melting metallic copper with tin ore, and from metal obtained by smelting a mixed ore of copper and tin in a primitive furnace in the metallurgical workshop of the Royal School of Mines, were exhibited. He also showed conclusively that the opinion held by many of the existence of a universal Copper age in Europe, intermediate between the Bronze and Stone periods of culture, was not warranted by the facts of the case.

Geological Society, January 24.—Dr. J. E. Marr, F.R.S., president, in the chair.—The igneous and associated sedimentary rocks of Llangynog (Caermarthenshire): T. C. **Cantrill** and H. H. **Thomas.** The sedimentary rocks associated with the igneous masses comprise Lower Old Red Sandstone, Didymograptus-bifidus beds, and Tetragraptus beds of the Ordovician. They occur in two anticlines, overfolded, and complicated by thrusts. The igneous rocks occur in three well defined areas, which belong to the same petrographical province. Both interbedded and intrusive rocks are represented; the latter include diabases and a large porphyry mass. The extrusive rocks occur in the following order:—(1) augite-andesites; (2) rhyolites; and (3) augite-andesites. The extrusive rocks are interbedded with fluxion-breccias and with tuffs; they are associated with the lower members of the Tetragraptus beds, and are consequently of Lower Arenig age; while the intrusive rocks have been injected into the extrusive rocks, and have also affected the Tetragraptus beds.—The Buttermere and Ennerdale granophyre: R. H. **Rastall.** From the facts put forward it is concluded that the intrusion is an example of an acid-magma, which has crystallised under the set of conditions that gives rise to a perfect development of granophyric structure. The masses appear to be of the "cedar-tree" laccolite type intrusive about the junction of the Skiddaw Slates and the Borrowdale rocks. Besides the normal acidic rock, there are some marginal patches of more basic character, showing obvious genetic relationship. These basic forerunners afford evidence of differentiation of the magma before intrusion an example of Prof. Brögger's deep-magmatic differentiation. Considered as a whole, the character of the magma shows closer affinity to the tonalite group than to the true granites. The more basic types include dolerites, quartz-dolerites, and a rock type intermediate between quartz-dolerites and granophyres. There is also a development of peculiar rock types as the result of the re-mixing of previously differentiated partial magmas of an acid and a basic character respectively.

Challenger Society, January 31.—Dr. R. N. Wolfenden in the chair.—Four deep-water Caridæ from the west coast of Ireland: S. W. **Kemp.** *Acanthephyra purpurea*, a species showing so great variation that it is now possible to rank six other "species" as its synonyms; *A. debilis*, a very rare species with about 100 luminous organs; *Ægeon brendani*, and *Leontocaris lar*, spp. nn.—Report on the Chætognatha of the *Siboga* expedition in the Dutch East Indies: Dr. **Fowler.** Of sixteen species, only one appeared to be new. Among those taken only in deep

hauls were *Sagitta macrocephala* and *S. zetesios*, known only from deep water in the Atlantic, and *Krohnia hamata*. The species captured at the surface supported the alleged uniformity of the Indo-Pacific epiplankton. A systematic revision of all species hitherto described left twenty-four as valid. A revision of all captures of Chætognatha hitherto recorded appeared to show one (*hexaptera*) as cosmopolitan and pantothermal, others as eurythermal, and having a wide but not a universal range, others as confined to a limited area and stenothermal. As regards depth, four have been only recorded from the mesoplankton; two at the surface in polar waters seek the mesoplankton in warm seas; others are confined to the epiplankton. According to temperature, species appear to fall into five classes:—cold water species with a maximum of about 12° C., temperate species, warm water species with a minimum of about 16° C., species with a wide range of temperature, and a single pantothermal species. The writer also presented a note on Antarctic and sub-Antarctic Chætognatha taken on the *Discovery* and *Challenger* expeditions; these established *Krohnia hamata* as truly bipolar, from 81° 30′ N. to 77° 49′ S., and completed the cosmopolitan record of *hexaptera*; they also enabled the N. limit of *hamata* at the surface, and the S. limit of *serratodentata*, to be determined approximately.

Chemical Society, February 1.—Prof. R. Meldola, F.R.S., president, in the chair.—Hydroxylamine-$\alpha\beta$-disulphonates: T. **Haga**. These salts, obtained by hydrolysis of Fremy's *m*-sulphazilates, are decomposed by sodium amalgam, and are proved by the nature of this change to be hydroxylamine-$\alpha\beta$-disulphonates. This is believed to be the first indisputable case of the occurrence of fundamental structural isomerism among inorganic compounds.—Studies in the camphane series, part xxi., benzenediazo-ψ-semicarbazinocamphor and its derivatives: M. O. **Forster**. Compounds of this class have been obtained from diazotised aniline, *p*-toluidine, &c.; they are characterised by the readiness with which dilute alkalis resolve them into camphoryl-ψ-carbamide and the corresponding phenylazoimide.—The relations between absorption spectra and chemical constitution, part i., the chemical reactivity of the carbonyl group: A. W. **Stewart** and E. C. C. **Baly**. It is pointed out that in certain cases the phenomena of tautomerism furnish an explanation of the exceptional reactivity of the carbonyl group. From spectroscopic evidence it appears that in the α-diketones a vibration is going on, which, to a certain extent, resembles that which was found in the case of ethylacetoacetate and its derivatives. The nature of this vibration cannot be easily expressed in the ordinary structural formulæ without the possibility of misconception, but it may be indicated somewhat as follows:—The vibration is brought about by some change in the relations between the carbon and oxygen atoms, and in some respects resembles the transition from the ketonic to the enolic form and back again. Using this analogy, it may be postulated that the two extreme phases of the vibration can be represented by the formulæ

$$\begin{array}{ccc} \text{—C.O} & \qquad & \text{—C:O} \\ \| \;\; | & & \\ \text{—C.O} & & \text{—C O} \\ \text{I.} & & \text{II.} \end{array}$$

It is proposed to call the general phenomenon "isorropesis," and to call "isorropic" those radicals the activity of which is thus produced.—The relation between absorption spectra and chemical constitution, part ii., the quinones and α-diketones: E. C. C. **Baly** and A. W. **Stewart**. In this paper it is shown that isorropesis in α-diketones results in the absorption of light in the visible blue region, so that the substances are intensely yellow. This is evidenced by camphorquinone and diacetyl. These observations strongly support Armstrong's theory that the colour of certain benzene derivatives is due to the quinonoid linking, for they show that the colour is caused, not directly by this linking, but by the isorropesis between the unsaturated atoms where this linking exists.—The relation between absorption spectra and chemical constitution, part iii., the nitranilines and the nitrophenols: E. C. C. **Baly**, W. H. **Edwards**, and A. W. **Stewart**. In this paper are described the absorption spectra of compounds having the quinonoid linking and containing a nitrogen atom in place of one or both of the quinone oxygen atoms. In the discussion, Prof. Armstrong said that Mr. Baly had put aside entirely the view which had long been held that ketonic interactions were conditioned by the combination of various substances with the carbonyl group, and had adopted an entirely *intra*-molecular view of change, whether chemical or physical. He still adhered to the opinion that three absorbing centres were required to produce visible colour, *i.e.* that iodoform, not methylene iodide, might be taken as typical of coloured substances. The colour of compounds such as diacetyl might be accounted for on the assumption that polymeric molecules were present, formed by the association, through the residual affinity of the oxygen atoms, of the ketonic groups, *e.g.*

$$\begin{array}{l} CH_3.\underset{\cdot\cdot}{C}\text{—}\underset{\cdot\cdot}{C}.CH_3 \\ \quad\;\; O \;\;\; O \\ \quad\;\; \dot{O} \;\;\; \dot{O} \\ CH_3.\dot{C} \;\;\; \dot{C}.CH_3. \end{array}$$

This explanation might perhaps also apply to metanitrophenol and metanitraniline. He remarked subsequently that the blue colour of water might be accounted for from this point of view, but not by Mr. Baly's hypothesis.—The action of light on benzaldehydephenylhydrazone: F. D. **Chattaway**.—The union of chlorine and hydrogen: C. H. **Burgess** and D. L. **Chapman**.—Note on the molecular weight of epinephrine: G. **Barger** and A. J. **Ewins**.—The critical temperature and value of ML/Θ of some carbon compounds: J. C. **Brown**. The value of ML/Θ rises very slightly with the increase of CH_2 in the aliphatic alcohols, acids, and esters, but is very constant for the aromatic hydrocarbons.—Slow oxidations in the presence of moisture: N. **Smith**.—Fischer's salt and its decomposition by heat: P. C. **Rây**.—Action of quinones on *o*-diamines, *o*-nitroaniline, *m*-nitroaniline, and 2-nitro-*p*-toluidine. A preliminary note. Some oxidation products of the hydroxybenzoic acids, ii.: A. G. **Perkin**. When gallic acid dissolved in 76 per cent. sulphuric acid is oxidised by means of potassium persulphate, a colouring matter very similar to ellagic acid is produced. This substance, to which the name flavellagic acid is assigned, is probably hexahydroxydiphenylmethylolid.—Contributions to the chemistry of oxygen compounds, part i., the compounds of tertiary phosphine oxides with acids and salts: R. H. **Pickard** and J. **Kenyon**.—The rapid electro-analysis of metals, preliminary note: H. J. S. **Sand**.

Mathematical Society, February 8.—Sir W. D. Niven, vice-president, in the chair.—The Eisenstein-Sylvester extension of Fermat's theorem: Dr. H. F. **Baker**. Sylvester gave in 1861 an expression for the residue, to modulus p, where p is an odd prime, of the integer $(\gamma^{p-1}-1)/p$. The result admits of simple proof and of extension to the case where the modulus is not prime, and the expression obtained for the residue is shown to be one of a definite number of possible representations.—A chapter of the present state in the historical development of the elliptic functions: Prof. H. **Hancock**. The paper deals chiefly with the contributions of Cayley and Eisenstein to that method of developing the theory of elliptic functions which is usually associated with the name of Weierstrass.—The reduction of the ternary quintic and septimic to their canonical forms: Prof. A. C. **Dixon** and Dr. T. **Stuart**. The method employed in the reduction is Sylvester's extended dialytic method of elimination.—The scattering of sound by spheroids and discs: J. W. **Nicholson**. The diffraction of plane sound waves by a very small spheroid has been discussed by Lord Rayleigh. The paper is occupied with the development of formulæ suitable for expressing the scattered waves in the case where the axis of the spheroid is parallel to the direction of the incident disturbance, and the dimensions of the spheroid are sufficiently small compared with the wave-length for an approximation proceeding by powers of the ratio of the equatorial radius to the wave-length to be valid.—A preliminary communication on partitions of numbers in space of two dimensions was made by Major P. A. **MacMahon**.

DUBLIN.

Royal Dublin Society, January 16.—Dr. W. E. Adeney in the chair.—Secondary radiation from compounds: Prof. J. A. **McClelland** and F. E. **Hackett.** The secondary radiation of β particles emitted by substances when they are acted upon by the β rays of radium has been previously measured by one of the authors for a large number of elementary substances. In the present paper a number of chemical compounds have been tested experimentally, and the secondary radiations from the compounds have also been calculated on the assumption that the secondary radiation is an additive atomic property. The close agreement between the calculated and the experimental value shows that the assumption is fully justified. This result is then used to determine the secondary radiation from a number of elements not available in sufficient quantity in the pure state to enable them to be studied directly. The relations previously established between the secondary radiation and the atomic weight are found to hold for all the additional elements thus investigated.—Electromagnetic mass: Prof. A. W. **Conway.** The electromagnetic inertia of an invariable system of electric charges is considered. A quadric is obtained such that if the force has the direction of the radius vector, the "mass" in that direction is as the inverse square of the length, and the direction of the acceleration is the perpendicular on the tangent plane. The mean mass of any such system is $4/3\,C^{-2}$, the work necessary to assemble it from a state of infinite diffusion.—Note on the sublimation of sulphur at ordinary temperatures: R. J. **Moss.** Twenty-five years ago some fragments of ordinary stick sulphur were enclosed in a glass tube, which was then exhausted by a Sprengel pump and sealed. After the lapse of twenty years indications of the formation of a crystalline sublimate became apparent; during the past five years the crystals have increased in number and in size to a marked extent; some of them are now 0·2 mm. in length, and the sublimate is deposited on one side of the tube throughout its whole length. The crystals are apparently rhombic, and are much more complex than those deposited from sulphur solutions.

EDINBURGH.

Royal Society, February 5.—Prof. Crum Brown, vice-president, in the chair.—The relation between normal "take-up" (or contraction) and degree of twist in twisted threads: T. **Oliver.** The paper was chiefly devoted to the properties of two-ply twisted yarns. The effect of twisting together two already twisted single threads was studied theoretically, and special attention was directed to the lengthening in the early stages of the second twisting due to the opening out of the single threads as the second twist was applied in the opposite direction to that of the first twists. Formulæ were deduced connecting the change of length with the amount of twist, and these were then compared with the results of experiment. The comparison was satisfactory, the discrepancies being such as might naturally be expected when due consideration was given to the necessarily imperfect nature of the assumptions on which the theoretical calculations were made. For example, the beginning of the contraction in the second twisting, when experimentally tested, occurred at a later stage than was indicated by the theoretical formula, a discrepancy which could be explained by the extremely probable supposition that the yarn had acquired a "set" in one direction during the first twisting.—Some experimental results in connection with the hydrodynamical theory of seiches: P. **White** and W. **Watson.** These experiments were undertaken at the suggestion of Prof. Chrystal, and the results obtained gave striking confirmation of several of his theoretical conclusions. The seiches were generated in a rectangular trough 5 feet long and 4·5 inches wide. Various bottom contours were obtained by means of blocks of wood cut to the desired form, such as parabola, concave or convex, semi-parabola, symmetrical rectilinear slope, and the quartic form which Prof. Chrystal had found to lead to a simple solution. The seiches were started by the to-and-fro motion of a strip of wire gauze placed at the position of a node of the required seiche, and kept in proper periodic motion by means of an attached heavy pendulum the length of which could be adjusted. By this method seiches of nodalites as high as the fourth, fifth, and even seventh, had in certain cases been obtained. The periods of these were easily determined, but the positions of the nodes and ventral segments could not be determined with the same accuracy. Within the errors of observation, the agreement with theory was generally very close. It was found that with the convex parabolic bottom the seiches were not so persistent as in the case of the concave bottom, but that the trinodal was more persistent than the uninodal. With the quartic contour of bottom the seiches were remarkably persistent up to that of the fourth nodality.

PARIS.

Academy of Sciences, February 5.—M. H. Poincaré in the chair.—On the existence of insoluble potassium compounds in the trunk and bark of the oak: M. **Berthelot.** On the rotatory powers of hexahydrobenzylidene and œnanthylidenecamphors and their corresponding saturated derivatives, compared with the rotatory powers of benzylidene and benzylcamphors: A. **Haller** and F. **March.** These compounds were chosen for comparison since they contain the same number of carbon atoms, the substituting groups, benzylidene, hexahydrobenzylidene, and œnanthylidene, containing gradually increasing numbers of hydrogen atoms. Details are given of the methods of preparation of the various compounds, and of their physical properties. The conclusion is drawn that in benzylidenecamphor and its analogues, as in the benzylcamphors, it is the unsaturated character of the benzene ring which exerts its action on the elevation of the rotatory power of the asymmetric molecule to which it is attached.—Contribution to the chemical study of sea-water: Th. **Schlœsing.** A discussion of the results of chemical analyses of samples of sea-water taken at various points in the Mediterranean. The water of the Mediterranean differs from that of the Atlantic only by its degree of salinity, the mineral constituents of the two oceans being nearly identical.—Quasi-waves of shock, and the distribution of temperature in these quasi-waves: P. **Duhem.**—The provisional elements of the comet 1906*a*: E. **Maubant.** The calculations are based on observations made on January 29, 30, and 31.—Observations made on the sun at the Observatory of Lyons with the 16 cm. Brunner equatorial during the third quarter of 1905: J. **Guillaume.** The results of observations on forty-four days are summarised in three tables giving details of the spots, their distribution in latitude, and the distribution of the faculæ in latitude.—A problem in the calculus of variations: Erik **Holmgren.**—The general solution of the problem of equilibrium in the theory of elasticity, in the case where the displacements of the points of the surface are given: A. **Korn.**—Some results of the triangulation of the Pelvoux-Écrins massif: Paul **Helbronner.** The present paper deals with the rectification of the heights of some of the important peaks.—The condensation of the acetylenic nitriles with alcohols. A general method of synthesis of β-substituted β-oxyalkyl acrylic nitriles: Ch. **Moureu** and I. **Lazennec.** The nitrile $R—C\equiv C—CN$ is treated with alcoholic potash; the product is poured on to ice, extracted with ether, and submitted to distillation in a vacuum. The compound $R—C(OC_2H_5)=CH—CN$ is thus obtained. In the case of the aromatic compounds, this substance is easily hydrolysed by heating with dilute sulphuric acid, furnishing the ketone $R—CO—CH_2—CN$; with fatty compounds the hydrolysis is more difficult, and generally results in further changes.—Attempts at reduction in the diphenylamine series: H. **Duval.** A study of the effects of stannous chloride and zinc dust in alkaline solutions on azo-diaminodiphenylmethane.—Cyclohexylacetone: P. **Freundler.** The only method, out of several tried, which has given the desired ketone is the condensation of the iodide of hexahydro-benzyl-magnesium with acetaldehyde. The secondary alcohol thus obtained is oxidised to the ketone with chromic acid mixture. The yields are not good.—The absorption of alkaline carbonates by the mineral constituents of the soil: J. **Dumont.**—Observations on the preceding note: L. **Maquenne.**—The passage through the spinal ganglions of bundles arising from the motor roots and leading to the dorsal nerves in the Batrachians: P. **Wintrebert.**—The action of hordenine sulphate on soluble ferments and on micro-organisms: L. **Camus.** The sulphate of hordenine

retards the action of pepsin, trypsin, and rennet, but is without action on invertine, maltase, and lipasidin. It exerts an antiseptic action on bacilli.—The proportions of chloroform contained in arterial blood during anæsthesia and the effects produced: J. **Tissot.** There appears to be no direct proportion between the amounts of chloroform present in arterial blood and the anæsthetic effects produced.—Contribution to the study of the pathological anatomy of epithelial cancers of the prostate: MM. **Motz** and **Majewski.**—Trepanning and ventricular puncture in brain disease: O. **Laurent.**—The existence of limestone breccias in the mountains to the south-east of Mt. Blanc: M. **Kilian** and P. **Lory.**—Results of magnetic observations made at the Observatory of Athens during the years 1900–1903: D. **Éginitis.**—Note on an earthquake shock at Ebro: P. **Cirera.** The instruments at the Observatory of Ebro registered a shock between 3.47 p.m. and 6 p.m. on January 31. The magnetograph showed corresponding disturbances.

New South Wales.

Linnean Society, November 29, 1905.—Mr. T. Steel, president, in the chair.—Further notes on hybridisation in the genus Eucalyptus: J. H. **Maiden.** This paper briefly recapitulates recent work on the subject, directs attention to the fact that the credit of the discovery of natural hybridisation in this genus belongs to George Caley, whose observations were made in New South Wales before 1810, and indicates the guides which point to a natural hybrid.—Miscellaneous notes (chiefly taxonomic) on Eucalyptus, part ii.: J. H. **Maiden.** Reasons are given for the contention that the blue or flooded gum of coastal New South Wales (*E. saligna*, Sm.) cannot in reality be separated from the Bangalay (*E. botryoides*, Sm.), and the name var. *botryoides* is proposed for the latter.—On an undescribed species of Cryptocarya from eastern Australia: R. T. **Baker.**—Studies on Australian Mollusca, part ix.: C. **Hedley.** The marine molluscan fauna of New South Wales is enlarged by the addition of new species of Eulimella, Diala, Actæon, Mitromorpha, Rissoa, Bornia, and Cyamiomactra.—Descriptions of three new Australian species of the genus Austrogomphus (Neuroptera: Odonata): R. J. **Tillyard.** (1) A pleomorphic slime-bacterium; (2) the probable identity of the opsonins with the normal agglutinins: R. Greig **Smith.**

DIARY OF SOCIETIES.

THURSDAY, February 15.

Royal Society, at 4.30.—The Influence of Increased Barometric Pressure on Man. No. 1: Dr. L. Hill, F.R.S., and M. Greenwood.—On the Existence of Cell-communications between Blastomeres: C. Shearer.—Innervation of Antagonistic Muscles. Ninth Note: Successive Spinal Induction: Prof. C. S. Sherrington, F.R.S.—The Chemical Constitution of Protoplasm as shown by the Rate of Tissue Disintegration: Dr. H. M. Vernon.—The Development of the Head-Muscles of the Common Fowl (*Gallus domesticus*), together with some Remarks on the Head-Muscles of Reptiles: Prof. F. H. Edgeworth.—Observations on the Labyrinth of Certain Animals: Dr. A. A. Gray.

Chemical Society, at 8.30.—Cuprous Formate: A. Angel.—The Solubility of Triphenylmethane in Organic Liquids with which it forms Crystalline Compounds: H. Hartley and N. G. Thomas.—The Spontaneous Crystallisation of Supersaturated Solutions: H. Hartley.—The Preparation and Properties of some New Tropeines: H. A. D. Jowett and A. C. O. Hann.—Studies in Asymmetric Synthesis, Part IV., The Application of Grignard's Reaction for Asymmetric Syntheses: A. McKenzie.

Linnean Society, at 8.—The Structure of *Isis hippuris*: J. J. Simpson.—Note on the Geographical Distribution of the Genus Shortia, Torr. and Gray: B. Daydon Jackson.—*Exhibition*: Developmental Changes in Zooglœa (with Lantern Slides): Dr. H. Charlton Bastian, F.R.S.

Society of Arts, at 4.30.—The Navigable Waterways of India: R. B. Buckley, C.S.I.

Institution of Mining and Metallurgy, at 8.—Pyritic Smelting: R. C. Alabaster and F. H. Wintle.—The Acme Combined Concentrating Table: L. H. L. Huddart.—Stadia in Careful Work: A. H. Webb.—The Detailed Mapping of Stoping Areas: H. R. Sleeman.—Sinking, Development and Underground Equipment of Deep Level Shafts on the Rand: A. E. Pettit.—The Hydraulic Filling of a Coal Seam at Lens, Pas de Calais, France: L. E. Hill and M. Butt.

FRIDAY, February 16.

Royal Institution, at 9.—The Passage of Electricity through Liquids: W. C. D. Whetham, F.R.S.

Institution of Mechanical Engineers, at 8.—Large Locomotive Boilers: G. J. Churchward.

Geological Society, at 3.—Annual General Meeting.

SATURDAY, February 17.

Association of Teachers in Technical Institutes (Regent Street Polytechnic), at 7.30.—The Teaching of Mathematics to Engineering Students: G. E. St. L. Carson.—The Teaching of Mathematics to Building Trade Students: H. Bustridge.

MONDAY, February 19.

Society of Arts, at 8.—Modern Warships: Sir William White, K.C.B., F.R.S.

Victoria Institute, at 4.30.—The Bible Pedigree of the Nations of the World: M. L. Rouse.

TUESDAY, February 20.

Royal Institution, at 5.—Food and Nutrition: Prof. W. Stirling.

Institution of Civil Engineers, at 8.—A Plea for Better Country Roads: G. R. Jebb.—Country Roads for Modern Traffic: J. E. Blackwall.

Royal Statistical Society, at 5.—Wages in the Engineering and Shipbuilding Trades in the Nineteenth Century: A. L. Bowley and G. H. Wood.

Zoological Society, at 8.30.

WEDNESDAY, February 21.

Society of Arts, at 8.—Fisheries of the North Sea: Walter Garstang.

Geological Society, at 8.—The Constitution of the Interior of the Earth, as revealed by Earthquakes: R. D. Oldham.—The Tarannon Series of Tarannon: Miss Ethel M. R. Wood.

Royal Microscopical Society, at 8.—On an Improved Method of taking Stereophotomicrographs and of Mounting the Prints: H. Taverner.—Exhibition of Slides of Oribatidæ, presented by N. D. F. Pearce.

Royal Meteorological Society, at 7.30.—Report on the Phenological Observations for 1905: E. Mawley.—Discussion of the General Features of the Pressure and Wind Conditions over the Trades-Monsoon Area: W. L. Dallas.—The Dispersal or Prevention of Fogs: Dr. W. B. Newton.

Sociological Society (School of Economics and Political Science, University of London, Clare Market, W.C.), at 8.—A Practicable Eugenic Suggestion: W. McDougall.

THURSDAY, February 22.

Royal Society, at 4.30.—*Probable Papers*: On the Coefficient of Viscous Traction and its Relation to that of Viscosity: Prof. F. T. Trouton, F.R.S.—An Account of the Pendulum Observations made at Kew and Greenwich Observatories in 1903: Major G. P. Lenox-Conyngham.—And other Papers.

Institution of Electrical Engineers, at 8.—Crane Motors and Controllers: C. W. Hill.

FRIDAY, February 23.

Royal Institution, at 9.—The Internal Architecture of Metals: Prof. John O. Arnold.

Physical Society, at 5.

Institution of Civil Engineers, at 8.—The Graphical Determination of the Deflection of Beams: C. H. Sumner.

CONTENTS.

regarded by many people as something quite *chic* and up to date!

In conclusion, Mr. Cunynghame may claim to have presented us with a very clear and well expounded introduction to the important subject of which his book treats.

G. H. B.

TWO EGG-BOOKS.

(1) *Ootheca Wolleyana: an Illustrated Catalogue of the Collection of Birds' Eggs formed by the late John Wolley.* Edited by Alfred Newton. Part iii., Columbæ to Alcæ. (London: R. H. Porter, 1905.) Price 2*l.* 2*s.*

(2) *Eggs of the Native Birds of Britain and List of British Birds, Past and Present.* By W. J. Gordon. Pp. 64; 398 illustrations. (London: Simpkin, Marshall and Co., Ltd., 1905.) Price 3*s.* 6*d.*

In the first of these two books Prof. Newton makes good progress with the catalogue of the unrivalled collection of eggs to which it is devoted, dealing in this instance with the pigeons, game-birds, rails, cranes, bustards, waders, gulls, and auks. Needless to say, it is written in the same style as its two predecessors, consisting almost entirely of Mr. Wolley's original notes, with such comments as the editor considered it advisable to intercalate here and there. To review the fasciculus is impossible within the limits of our space, and we can only refer to a few points of special interest. One of these relates to the eggs of the knot, of which a presumed specimen, laid in confinement, was given to the author by Lord Lilford; the correctness of this identification has been recently confirmed by the discovery of "wild" specimens. Equally interesting is the record of the first known egg of the stint, obtained by Middendorf in Siberia in 1843. The culminating interest of this fasciculus is, however, concentrated on the superb series of eggs of the great auk possessed by Mr. Wolley, which included no less than seven actual specimens, together with several casts. The first of the originals the author bought in 1846 for twenty-eight shillings; it may, perhaps, be now worth ten times as many pounds! Coloured figures (two of each) of the seven auks' eggs and of one of the casts form the illustrations to this fasciculus; and in the execution of these plates Mr. H. Grönvold has surpassed himself, having succeeded not only in showing the colouring and markings to perfection, but also in imitating to a nicety the very grain and texture of the shell. The eight specimens show very clearly the range of variation to which the colour and markings of the eggs of the species were subject.

Mr. Gordon's little book, which is, of course, a work of quite a different class from the last, is a well-intended attempt to place before the public, at a very low price, a satisfactory means of identifying the eggs of those birds which nest in the British Isles, or did so until within a comparatively recent period. That the author has taken great pains in grouping and photographing these eggs is perfectly evident, and if the colouring of the figures is in some instances not quite so true to nature as might be desired, this can scarcely be considered his fault, while, if the low price at which the book is published be taken into consideration, it would be almost unfair to lay the blame on the lithographer. We cannot have perfection combined with cheapness in matters of this sort, and, considering its price, the book is a very creditable production.

In including extinct species of British birds in the list at the end of his work, Mr. Gordon has, we think, been ill-advised, as the majority of these are very imperfectly known, and they are not likely to interest the class of readers to whom this volume will appeal. Still, the inclusion is evidence of broad views on the part of the author. Both Prof. Newton and Mr. Gordon, we are glad to find, remain staunch conservatives in the matter of nomenclature, both as regards the use of generic terms in a wider and more comprehensive sense than is now, unfortunately, the fashion, and above all in eschewing the detestable "*Pica pica*" system. In both these respects, we venture to think, Mr. Gordon's work (the other does not, of course, appeal to the same class) will be far more acceptable to the general public than would have been the case had the author been induced to yield to the prevalent (and we trust fleeting) fashion

R. L.

OUR BOOK SHELF.

Engineering Chemistry: a Manual of Quantitative Chemical Analysis for the Use of Students, Chemists, and Engineers. By Thomas B. Stillman. Third edition. Pp. xxii+597. (Easton, Pa.: The Chemical Publishing Co.) Price 4.50 dollars.

At the present day chemical knowledge is so important a factor in the successful conduct of nearly all technical work that such books as Stillman's "Engineering Chemistry" appeal to a very large audience, and so well has the professor of analytical chemistry in the Stevens Institute done his work that the third edition will be as warmly welcomed as its predecessors. In it much of the work has been revised, the most modern standard methods introduced, and a considerable amount of new matter added, those portions on lubricating oils and the technology of the blast furnace being especially noticeable.

In so excellent a work criticism always seems ungracious, but there are a few points the author would do well to correct in the next edition. For instance, on p. 169 the author gives as a typical analysis of London coal gas

Hydrogen	27·70
Methane	50·00
Carbon monoxide	6·80
Ethylene	13·00
Nitrogen	0·40
Oxygen	0·00
Carbon dioxide	0·10
Aqueous vapour	2·00
	100·00

and calculates that it would have a heating value of 870·15 B.T.U.'s gross.

Such an analysis is so absurdly wrong that it can only have been inserted by error, the main constituents more nearly approximating to hydrogen 50 per cent., methane 36 per cent., and ethylene 4 per cent.

Moreover, the author on p. 183 says that London coal gas has an illuminating value of 16 to 17 candles, and a calorific value of about 668 B.T.U.'s, which is much more nearly true for the gas supplied by the Gas Light and Coke Co. The error is of importance, as an engineer working at the problem of the gas-engine and consulting records of efficiency made with London gas might be seriously misled.

In dealing with water gas, no mention is made of the more modern processes such as the "Dellwik," now so largely used for the production of blue gas for welding, as well as for diluting coal gas.

It is admitted in the preface that the article on practical photometry has not been brought up to date, and this is a pity, as more than seven pages are devoted to the Bunsen photometer and the manipulation of candles, now practically extinct in all but name as a standard of light, whilst a couple of pages on pentane standards would have been of real value.

In spite of a few blemishes, the whole work is so good that no engineering chemist can afford to be without it.

Die Photographie im Hochgebirg. By Emil Terschak. Second edition. Pp. xxiii+62. (Berlin: Gustav Schmidt, 1905.) Price 2.50 marks.

EVERYONE who is of a roving disposition, and takes his camera to Switzerland or the Tyrol, or any other region where mountain climbing is pursued, should, if he wishes to gain by the experience of others, read this book. It is written by a photographer to photographers, and is not only very interesting to read, but contains a great amount of very useful photographic information of a particular kind.

The successful photography of mountain scenery, of ice, snow, and clouds at high altitudes requires not only forethought, but much experience. As it is necessary to carry all the apparatus that is required, the equipment must be well attended to, and since also one does not necessarily wish to climb high altitudes to take again a particular view that has not turned out photographically successful, one must be sure of securing a good negative at every exposure.

The first edition of this book appeared in 1900, but the author has since gained much more useful knowledge, which he has embodied in the present edition. The book is clearly printed in Roman characters on good paper, and the illustrations are numerous and well reproduced.

The Royal Medical and Chirurgical Society of London. Centenary 1805–1905. Written at the request of the President and Council by Dr. Norman Moore and Stephen Paget. Pp. 337. (The Aberdeen University Press, Ltd., 1905.)

THOUGH not the oldest of the medical societies of London, the Royal Medical and Chirurgical Society holds a position second to none, and the present volume of chronicles will not only be welcomed by its Fellows as giving a history of their society, but forms a useful record of the art and science of medicine during the nineteenth century, with comments by the compilers. A noteworthy feature of the volume is the list which is given for each year of the principal papers read before the society, both published and unpublished, extracts being given from the more important ones. Thus, for the year 1833, we find Hilton's unpublished account of *Trichina spiralis* in human muscle, which ante-dated Paget's discovery of this parasite. Short bibliographies of all the presidents and a full index complete this interesting volume, which contains several illustrations of the various premises occupied by the society and a photogravure frontispiece of William Saunders, the first president.

R. T. HEWLETT.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Tidal Researches.

IN NATURE for January 11 (p. 248) appear some criticisms upon my paper entitled "Cotidal Lines for the World."

The critic says:—"The construction of these charts is, unfortunately, but vaguely indicated." In reply to this it may be said that the charts embody all data known to me at the time of their construction, and to such data references as copious as space seemed to permit are given. What is meant by cotidal lines is given in § 17. Notions relating to the local modifications or peculiarities of cotidal lines have been given in considerable detail by means of lemmas and examples. In the construction of these lines, large detailed charts showing soundings wherever known were employed, and these depths were carefully considered in each step of the process. The ranges of tide written along the shore-lines simply represent data, and in no way depend upon any theory or hypothesis. The same is essentially true of the cotidal lines where observations or data are sufficient. Wherever harmonic constants are available, the length of the series analysed is of secondary importance in the construction of cotidal lines, the results from two months being about as satisfactory as those from twenty years.

If we are not permitted to extend cotidal lines outward from the shore, we might about as well draw them upon the land as upon the water, for in either case they would only serve to point out the shore values. The reviewer thinks well of Berghaus's chart, and so do I. However, it is difficult to believe that a philosophical critic could long rest content with cotidal lines extending but a short distance off shore, and forming no connected or consistent system. Of course, the attempt, on my part, at covering all seas does not imply that all charts are equally good. In some instances the data were very meagre, and attention was directed to this fact more than once in the paper.

It seems strange that any serious misunderstanding could exist in reference to the method employed in inferring the times when the water particles are at elongation in particular directions. Does anybody doubt the conclusions reached in § 56, part iv. A? If these conclusions are wrong, let us hear the correct ones. If §§ 60–65, part iv. A, are not clear as they stand, it seems as if § 24, part iv. B (to say nothing of a reply to former criticism, NATURE, April 23, 1903), ought to remove all obscurity.

Perhaps the following remarks may be of some service in this connection:—

Unless the free period of a body of water, or of some portion of this body, approximately agrees with the period of the tidal forces, the tide in the body proper must be small, and generally smaller than the theoretical equilibrium tide for the body in question. But in many parts of the oceans the tide is several times greater than that which could be raised by the forces, even if we could suppose sufficient depths and sufficiently complete boundaries for enabling equilibrium tides to occur. Hence regions the dimensions of which approach critical values must exist in the oceans and account for the principal tides. If the aërial vibrations accompanying a musical tone act upon a series of resonators suited to various pitches, the one or more constructed for the given tone will respond to it, while all others will be practically silent; that is, the dominant impressed motions belong to resonators having critical dimensions, and not to the resonators in general.

That stationary oscillations of unexpectedly large amplitude exist in the oceans there is abundant evidence. In fact, a glance at the charts under criticism will show regions of large ranges over each of which the time of tide varies but little. As a nodal line is approached the range diminishes, and the time of tide changes rapidly in a comparatively short distance. Moreover, the dimensions of the oceans are such that areas having nearly critical

lengths can be readily discovered; these respond well to the forces, and their tides must be the ruling semi-diurnal tides of the oceans. The charts prove the existence of large stationary oscillations. To doubt this fact would be scarcely more reasonable than to doubt the existence of the tide itself. The large ranges of tide imply critical lengths, and critical lengths imply that the phase is controlled by the resistance to the movement.

In a second approximation it may be possible to take into account the actual departures from critical lengths, to make some numerical estimates of the resistance, and to fix more accurately the modes of oscillation having regard to the deflecting force of the earth's rotation. In my paper the latter effect has been considered only in reference to arms or bodies of water tidally dependent upon larger bodies.

As soon as my critics develop their tidal theories sufficiently far for making definite suggestions, I shall be pleased and bound to give such developments careful consideration. In the meantime, I believe that nothing is gained by criticism which does not constantly revert to such facts as have been brought out through observations upon the tides. These constitute the final test of all theories. R. A. Harris.

Washington, D.C., January 26.

It is Mr. Harris's theory with which we were, and continue to be, at variance. We were unable to gather the part played by this theory in the construction of his series of cotidal charts, and hence our statement that this construction was but "vaguely indicated"; but we are glad to be assured that the theory has only been employed in regions where observational data were entirely wanting, and has not been allowed to vitiate, as we feared, results obtained direct from observation.

In reference to the phase theorem which we selected for special comment, Mr. Harris now states that "the large ranges of tide imply critical lengths, and critical lengths imply that the phase is controlled by resistance." The latter part of this theorem we are not prepared to admit unless it be further contended that the critical conditions implied are mathematically *exact*, especially in consideration of the comparatively small frictional influences which can be brought to bear on the motions of the sea. Any departure from the ideal critical state, and we contend that such departures must inevitably occur in a complex system like that of the ocean, will render the determination of phase dependent on such departures as well as on frictional influences, and we differ from Mr. Harris in regarding the former rather than the latter as the more powerful controlling influence in regard to phase. Whence can the large resistances to motion, implied in Mr. Harris's theory, arise? S. S. H.

Atomic Disintegration.

According to the investigations on radium, especially by Prof. Rutherford, there can be no longer any doubt that the formation of helium from radium is due to spontaneous disintegration of the radium atom, and it is the same with the other radio-active elements. Most competent investigators have not hesitated to apply the same point of view also to all the other elements.

The enormous amount of energy set free in the formation of helium—about 10^9 great calories for a gram-atom of helium—must render hopeless any attempts to reverse this process. Considering the conformity of the other gases of the helium type—neon, argon, krypton, and xenon—it seems probable that they owe their existence to a similar disintegration of atoms. It is not surprising, therefore, that all attempts have failed to obtain a chemical compound of those gases, and I do not think such attempts likely to succeed in future. That, as yet, those gases, excepting helium itself, have not been recognised as products of atomic disintegration may be due to their difficult test.

Now it seems to me there is nothing contrary to the view that *disintegration of atoms is an irreversible process, strictly analogous to dissipation of heat.*

Considered in this way, there exists a parallelism not only as regards the first law of thermodynamics—conservation of energy—with the principle of conservation of matter, but also regarding the second law—dissipation of energy, on the one hand, and atomic disintegration on the other. And as it has been stated by Clausius that the world's entropy tends towards a maximum, we may say that likewise the quantity of free helium and the similar "Edelgase" tends towards a maximum.

This parallelism in material and energetical law appears to me well worthy of notice. W. Meigen.

Freiburg i/Br.

Phosphorescence of Pyro-soda Developer.

Some time ago (January, 1904) you were good enough to publish a note on the "Phosphorescence of Photographic Plates," and the following additional particulars of this phenomenon may be of interest. The developer used is the ordinary pyro-metol-soda solution.

If a bromide plate is exposed in the camera, developed, washed for a few moments only, and then placed in aluminium sulphate solution in the dark, the picture becomes luminous and shows forth as a *negative*, the high lights being dark, whilst the shadows are bright, the darkest ones phosphorescing most strongly. If, however, the plate (after having been exposed and developed) is washed thoroughly for half an hour by means of a jet of water under pressure, no phosphorescence is observed on treating it with Al_23SO_4 solution, from which it appears that a trace of the developing solution is necessary to cause phosphorescence in the plate.

If a few spots of unused developing solution are placed in the bottom of a porcelain dish and Al_23SO_4 solution is added (in the dark), the mixture will phosphoresce. But if the developer has been used for developing exposed plates, then its power of phosphorescence is weakened, and if the same portion of solution is used repeatedly for developing, and tested periodically for phosphorescence between the developments, it will be found that its phosphorescing power is diminished after each development, and that it finally vanishes altogether. This explains the production of the phosphorescing negative. The most strongly lighted part of the film is that which will destroy the phosphorescing power of the developer it has absorbed, and the unlighted portion or shadow is that in which the absorbed developer will be least changed, and therefore most strongly phosphorescent.

The addition of various substances to the aluminium salt modifies its phosphorescing power, and some prevent it altogether, even when added in very small quantities. Among those substances which strongly counteract the phosphorescence may be mentioned the salts of thorium, uranium, copper, lead, bismuth, iron, tin, cobalt, nickel, chromium, zinc, cadmium, mercury, platinum, and silver in the order named, while the salts of potassium, sodium, ammonium, lithium, calcium, barium, strontium, magnesium, and manganese seem to have little influence one way or the other.

The only substance found which has the effect of much increasing the brilliancy of the phosphorescence is gold. A solution of $AuCl_3$ alone, in fact, gives a more brilliant phosphorescence than Al_23SO_4. The gold is reduced to the black metallic form, and while this reduction is proceeding light is emitted. Other reducing agents, however, do not appear to emit any light during the process of reduction of $AuCl_3$. The influence of the other metals on the phosphorescing power of the gold solution seems to be practically the same as for aluminium.

Other aluminium salts, such as the nitrate, phosphate (dissolved in HCl), chloride, &c., phosphoresce with pyrometol developer, but none so brilliantly as the sulphate.

T. A. Vaughton.

Ley Hill House, Sutton Coldfield, February 13.

Emission of Light by Kanal-strahlen Normal to their Direction.

In a former publication (*Physik. Zeitschrift*, vi., 892, 1905) I have proved that the stream of positive ions which form the Kanal-strahlen show the Doppler effect. In these rays we have, therefore, a positive charge, and at the same time velocity, and also, as a result of the vibrations of the negative electrons, emission of light. Therefore it is

exerting a pressure on the ions against the translation resulting from radiation; besides this force an electromagnetic force—of second order of the ratio of velocity of translation to velocity of light—may arise from the moved charges of the ions and act on the vibrating electrons. The experimental research of the light of Kanal-strahlen emitted normally to their direction has given the following results. The observations have been made on hydrogen; the velocity of the Kanal-strahlen was $0{\cdot}9.10^8$ and $1{\cdot}2.10^8$ cm. sec.$^{-1}$. The spectrograms were taken with a prism-spectrograph and with a concave grating of 1 metre radius.

The total radiation of the line spectrum ($H\alpha$, $H\beta$, . . .) is partially polarised, and the electrical vibrations parallel to the direction of translation have a greater intensity than the vibrations at right-angles to the direction of translation. The difference of intensities is very small.

The lines of hydrogen (when observed normal to the Kanal-strahlen) are displaced towards the red, when compared with the lines emitted by the slow ions in the negative glow. The displacement seems to be proportional to the wave-length, and also proportional to the square of velocity. The displacement of the centre of $H\beta$ is approximately 0·8 Ångström unit for a velocity of $1{\cdot}2.10^8$ cm. sec.$^{-1}$.

Besides this displacement there is observed a broadening of the lines; it seems also to be proportional to the square of velocity, and to increase somewhat with decrease of wave-length. The observations as to the splitting up into components of the broadened line, and also as to the polarisation of its edges, are not concordant enough in the different spectrograms, and are therefore not ready for publication. J. STARK.

Göttingen, January 6.

Inversion-point of the Joule-Kelvin Effect.

IN discussing the Joule-Kelvin effect for a fluid like hydrogen, which shows an inversion point above which heating takes place on free expansion, it is usually assumed that this point is unique. Thus, for example, Olszewski has fixed it experimentally at $-80°{\cdot}5$ C. An examination of the consequences of any of the usually assumed equations of state (such as Van der Waals's or Dieterici's) easily reveals the fact that it must in reality be a function of the pressures to which the gas is subjected. But this is not all. If these consequences are examined for the inversion point corresponding to an infinitesimal change in pressure, it is seen that all the equations of state (which at the same time indicate a critical point) demand that there shall be *two* inversion points (if any) for any given pressure, and that, moreover, for sufficiently high pressures no inversion point will exist. Different equations of state, while unanimous in the above respects, indicate very different temperatures at which inversion should occur. I desire to point out, therefore, that a complete determination of the inversion points corresponding to various pressures affords an exceedingly sensitive means of discriminating between characteristic equations and of indicating the direction in which these require modification.

This matter is discussed in detail in a paper shortly to be published. ALFRED W. PORTER.

University College, W.C., February 19.

A Definition of Temperature.

A BODY containing heat is in a condition from which it tends to release itself (by radiating or conducting away heat), and this tendency only ceases when the body has passed into a heatless condition. The temperature of a body is the *measure* of its tendency at any instant to recover this heatless state (*cf.* Maxwell, "Theory of Heat," 10th ed., p. 32). This suggests a mechanical analogy; a body containing heat is analogous to an elastic medium in a state of strain, from which it tends to release itself in virtue of its restitutional forces; the magnitude of the restitutional force when a body is in a given strained condition measures its tendency to release itself from that strain, and so is analogous to the temperature of a body when in a given thermal condition. The quantity of work stored up in producing this strained condition, and which can be given out again when the body returns to its unstrained condition, is analogous to the quantity of heat the body contains when at a given temperature; it is quite easy to show that we can completely represent the thermal condition of a body by means of a model consisting merely of an elastic rod subjected to a tension. *A temperature, therefore, is analogous to a tension or pressure.* We are now in a position to give a real physical meaning to the "temperature" of a body, and so enable it to be measured in *absolute* units like a mass or a length. Let us take a molecular body devoid of all heat motion and plunge it into a medium the temperature of which is T. Then the medium will exert an intermittent pressure or force on the molecules, thus setting them into motion and generating heat motion in the body. It can easily be shown that this force cannot be infinite, or a cold body placed in a hot medium would *instantly* acquire the temperature of the medium, whereas it always takes a definite time to do so.

The *maximum force* which the medium exerts on a molecule at rest when placed therein is the numerical value of its temperature. Hence we arrive at the following definition of temperature:—

A molecule at rest when placed in a medium possessing temperature is subjected to an intermittent pressure; the greatest value of this pressure is the correct measure of the temperature of the medium in the neighbourhood of the molecule. Another method of stating the same thing is to say that the greatest force required to hold a molecule at rest when placed in a medium is the measure of the temperature of the medium. Still another statement is to say that the temperature of a medium is the magnitude of the force tending to drive heat motion into an absolutely cold body placed therein. A temperature, therefore, should be measured as a pressure in *dynes* per sq. cm. All the ordinary laws of thermodynamics, the flowing of heat from bodies of higher to bodies of lower temperature, Waterston's hypothesis, &c., follow quite simply as a consequence of this definition, as the reader can doubtless work out for himself. GEOFFREY MARTIN.

Kiel, February 10.

Chinese Names of Colours.

IN reply to the letter of Mr. Alfred H. Crook contained in your issue of January 11, I would say that it is possible that the explanation of the Chinese colour-name is to be found in the violet coloured halo which is very commonly noticed by Alpine climbers surrounding moving objects. Dr. Ellis attributes it, I believe, to fatigue of the eye (see discussion in NATURE, May, 1897).

REGINALD A. FESSENDEN.

IN your issue of January 11, Mr. Alfred H. Crook, of Hong Kong, asks why the Chinese should call a bright purple (almost a mauve) "snow green," and he adds that the term "green" is sometimes applied to the colour of the sky, which I take to mean blue. The following is a possible explanation:—

One of the commonest places in nature to find purplish hues is in shadows, and shadows on the snow, when the sky is clear, are decidedly purple. If purple is to be classified among the colours, it will go with the blues, hence "snow green" as meaning "snow blue" would not be such a misnomer as might at first sight appear.

Pittsburg, Pa., February 7. ALFRED SANG.

Sounding Stones.

MR. ALFRED TINGLE (January 4, p. 222) and Mr. Carus-Wilson (January 11, p. 246) may be interested to know that at the caves of Ellora, near Aurangabad, one of the pillars in the rock-cut temples has the same property of sounding under a blow.

The pillar is a massive one close to, or part of, the doorway leading to an inner shrine, and if struck with the clenched fist emits a deep note.

So far as I recollect, this property was confined to a portion of the pillar. W. G. BARNETT.

Poona, January 29.

THE NILE QUEST.[1]

THE story of the search for the sources of the Nile is the longest and most interesting in the annals of geographical exploration. It dates from the earliest days of geography; it has ever presented new problems; and the quarrel over the boundary between the Congo Free State and British East Africa, in the Upper Nile basin, is the latest example of political muddles due to geographical ignorance. The sources of the Nile roused speculation in the earliest days of Egyptian geography, owing to the mysterious rising of the Nile at the driest and hottest time of the year. The view that the river rises owing to the melting of equatorial snows was for long accepted; but it is now known to be the effect of the rainy season on the Abyssinian Mountains, as the contribution from the equatorial snowfields is insignificant, and even the great reservoir, the Victoria Nyanza, gives only a minor addition to the Egyptian floods. The story of the Nile is of especial interest to British students of geography, as the larger share to the solution of its problems has been contributed by British explorers, and practically the whole of the Nile basin, with the exception of Abyssinia, is now under British administration.

The story of the exploration of the Nile is here well and interestingly told. Sir Harry Johnston is known for his literary skill, and for the artistic sense which leads him to denounce (p. 161) "the unspeakable barbarism of the British Administration" in cutting down the fine trees that once grew beside the Ripon Falls; and his distinguished success in the administration of Uganda has given him an especial personal interest in the sources of the Nile, and full access to the latest information. His volume is worthy of a place among the excellent geographical handbooks in Dr. Scott Keltie's "Stories of Exploration." Sir Harry Johnston begins his narrative in the times when, as he tells us (p. 18), 2500 years ago, Phœnicians or Sabæans worked the goldfields of Rhodesia, and with the story of Diogenes, told to Marinus of Tyre in the first century, and preserved to us by the record of Ptolemy in the second century. He continues the history to recent surveys made under the British and Anglo-Egyptian administrations. The story is so long and so full that in 318 pages the author is able to give only brief sketches of the various expeditions. But he gives an exceptionally complete list of them, and his short, critical sketches are a most useful introduction to the original literature. The most valuable part of the book is its account of the minor expeditions, and especially of those carried on from Khartoum from 1840 to 1860. The author writes with wide sympathy for the explorers of all races and all nations, and he gives foreign workers their full share of praise, including Mademoiselle Tinné, "the gracious demi-goddess" of the Egyptian Soudan, and Georg Schweinfurth, "one of the greatest of African explorers." He defends d'Abbadie against the unjust attacks of Beke, and reminds us that Paez and Lobo were predecessors of Bruce. He describes the journey of Marchand (p. 245) as "one of the most splendid feats in African exploration." The author perhaps somewhat underrates the early contributions of the Portuguese; but he reprints a copy of Dapper's map of 1686; so he enables the reader to judge for himself as to the extent of the facts then known about tropical Africa, and as to the nature of the mistakes made by European cartographers in their interpretation of the verbal reports of the untrained Portuguese travellers. D'Anville's map, which is much praised by the author, is less accurate in regard to the

FIG. 1.—A Hima of Mpororo, near Karagwe. From "The Nile Quest."

Upper Nile and the Victoria Nyanza than Dapper's, though issued nearly a century later, and nearly a century and a half later than some of the authorities whom Dapper copied. The Portuguese mistake of giving several outlets from Tanganyika, which Sir Harry Johnston says shows that the Portuguese were "ignorant of the simplest principles of hydrography," was a similar mistake to that made by his own hero, Speke, in giving too many outlets from the Victoria Nyanza. The author quotes with praise Scott-Elliot's "very neat and truthful little map of the eastern and southern flanks of Ruwenzori, a map which until quite recently has been somewhat overlooked by those who have compiled charts of this

[1] "The Nile Quest, a Record of the Exploration of the Nile and its Basin." By Sir Harry Johnston, G.C.M.G., K.C.B., in "The Story of Exploration," edited by Dr. J. Scott Keltie. Pp. 365 (London: Alston Rivers, Ltd.)

region" (p. 269). The ethnographical and zoological references in the book show high expert knowledge, but it may be noticed, perhaps with surprise, that on pp. 297 and 298 he accepts the theory of the marine origin of the fauna of Lake Tanganyika.

The illustrations in the book are numerous and excellent, and it is illustrated by two fine maps by Bartholomew, showing the orographic features, and the characteristics of the surface and vegetation in north-eastern Africa.

J. W. G.

FIG. 2.—In the Libyan Desert. From "The Nile Quest."

THE FORM OF THE ATOMS IN RELATION TO THEIR SPECTRA.

SINCE Balmer's important discovery in 1885 that it is possible to calculate the wave-lengths of the first nine lines of the hydrogen spectrum by means of a simple formula, the existence of series of lines, obeying simple mathematical laws, has been established in the case of the spectra of several other elements, notably by the researches of Rydberg and of Kayser and Runge. Among the various attempts that have been made to account for these series of lines, and, in general, for the different spectra, the most promising seems to be that of Prof. F. von Lindemann, of Munich, who in some recent papers[1] has more fully developed an idea that he was first led to enunciate in 1888, after the publication of Lord Kelvin's Baltimore lectures on molecular dynamics. Prof. von Lindemann's method consists, not in deriving an empirical relationship between the wave-lengths or frequencies of the spectral lines, but in investigating mathematically the possible waves which a hypothetical atom can send out into the luminiferous ether.

His assumptions are the simplest possible. His atom consists of a certain amount of elastic isotropic matter of definite shape. The mathematical theory of the different kinds of vibrations of which such a body is capable is well understood, but the actual working out for any special case is difficult because it depends on functions which have to be discovered for each shape, and are, generally speaking, new to mathematicians. The wave-lengths of each kind of vibration sent out into the ether appear always as roots of a transcendental equation involving those functions. Such an equation has an infinite number of roots, each when real corresponding to a definite line. One equation thus corresponds with a "series" of lines. The theory gives for one body a number of such equations, and therefore a number of such "series" of lines, which together form the whole spectrum. This agrees with observed facts.

Prof. von Lindemann investigates, in the first paper quoted, the case of a spherical atom, filled throughout with matter of a definite density and elasticity. In this case, which is comparatively a simple one, the

[1] "Zur Theorie der Spectrallinien," *Sitzungsber. Math. phys. Classen der Kgl. Bayer. Akad.*, 1901, xxxi., 441; 1903, xxxiii., 27; a lecture, printed in the *Suddeutsche Monatshefte* for September, 1905, of which a translation is published in the *Monist* for January of this year, contains a popular summary of the earlier work and an outline of results not yet published in detail.

calculation can be carried fairly far, but it is found that the spectral lines so deduced obey a law of distribution simpler than any that has yet been found by experiment to characterise any substance. Although atoms are usually assumed for physical calculations to be spherical, such a shape apparently is not really possessed by the atom of any substance; but by using the result established in this case, a simple relationship is shown to be necessary between the wave-lengths of the spectral lines of two *similar* elements and their atomic weights. If these two elements are conceived as being built up of the same material, having the same form, density, and elasticity, and only their size different, the wave-lengths of corresponding spectral lines of the two elements are shown to be proportional to the cube roots of their atomic weights; given the lines of one of the elements, those of the second element can be calculated from the equation

$$\frac{\lambda}{\lambda'} = \sqrt[3]{\frac{W}{W'}},$$

where λ and λ' are the corresponding wave-lengths, W and W′ the atomic weights of the two elements. The elements of the following groups are found to obey this rule with a greater or less degree of approximation:—

(1) Zinc, cadmium, and mercury.
(2) Magnesium, calcium, barium, and strontium.
(3) Silver, copper, and gold.

As an illustration, the following series of lines of magnesium and calcium may be given. The arrangement and wave-lengths are those adopted by Kayser and Runge.

Magnesium. Mg=24·4				Calcium. Ca=40·0.			
Subordinate Series.	n	Observed	Calculated	Observed	Difference	n	Subordinate Series
I	4	3838·46	4526·1	4527·1	−1·00	—	—
I	5	3097·06	3651·9	{3653·62	−1·72	—	—
				{3644·48	+7·42	5	I
I	6	2852·22	3363·1	3361·92	−0·82	6	I
I	7	2736·14	3226·2	3225·74	+0·46	7	I
I	8	2673·15	3152·0	3152·08	−0·08	8	I
I	9	2633·13	3104·8	3101·87	+2·93	9	I
I	10	2605·40	3072·1	—	—	—	—
II	3	5183·84	6102·1	6102·99	−0·80	—	—
II	4	3336·83	3934·5	3933·83	+0·67	—	—
II	5	2942·21	3477·2	3474·98	+2·32	5	II
II	6	2781·35	3279·8	3274·88	+4·92	6	II
II	7	2698·44	3181·8	3181·40	+0·40	7	II
II	8	2649·30	3123·9	3117·74	+6·16	8	II

From the similarity of their spectra, the elements in each of the foregoing groups appear to be similarly constructed, and the probability of this is strengthened by the analogy of their chemical properties. On the other hand, chemical analogy does not necessarily imply similarity of form in the elements, as is shown in the case of the alkali metals (lithium, sodium, potassium, rubidium, cæsium); these elements, in spite of their close chemical similarity, do not exhibit the simple relationship connecting wave-length and atomic weight found in the groups already named. Either these elements may be considered as built up of different kinds of matter, or if of the same material as possessing different shapes.

Assuming that matter is uniform, the shape of the atom may be varied, and instead of the simple sphere the case of an elongated ellipsoid of rotation, formed by revolving an ellipse round its major axis, may be considered. The mathematical theory shows that the spectral lines of such a luminous ellipsoid depend on three numbers, and that therefore these lines will be capable of arrangement in groups according to three principles. These numbers are obtained as the roots of certain transcendental equations, and are to be calculated from the lengths of the axes of the ellipsoid, its density and elasticity, a calculation, however, which on account of its difficulty is hardly practicable. The first of the three numbers determines a group of corresponding lines, a so-called series; the different possible values of the number determine a certain sequence of such series. The second number determines in each series a subordinate group of lines, and the third number a single definite line in each subgroup. The manner in which this third number enters into the calculation shows, moreover, that the frequencies of the single lines in the subgroups will exhibit among themselves constant differences, differences, that is, depending solely on the nature of the given ellipsoid. A type of distribution of the spectral lines is thus afforded by the theory which corresponds with the well known law of distribution established by Rydberg and by Kayser and Runge in the case of the alkali metals. The atoms of these metals (Li, Na, K, Cs, Rb) may therefore be considered as elongated ellipsoids of rotation, the axial lengths being fully defined in the case of each element, and different in the different elements.

A flattened ellipsoid of rotation, the so-called spheroid, is by calculation found also to give rise to groups, series, and subgroups, but the law of constant differences is not so generally applicable. The roots of the transcendental equations are, in this case, partly imaginary, so that several groups consist of a single strong line, others of a limited number of lines. Such a grouping is actually found in the case of the metals gold, silver, and copper. Hydrogen is also of this type, its atom probably consisting of a thin, round plate, which is to be considered as the limiting case of a flattened ellipsoid.

In the more general type of ellipsoid, that with three unequal axes, the wave-lengths of the spectral lines also depend on three numbers, defined by certain equations, but in this case the lines cannot be arranged in series and groups, but range over the whole spectrum. Only when the form of the ellipsoid approximates to that of an ellipsoid of rotation will a few series arise. Such a distribution appears to obtain in the spectra of the alkaline earths (barium, strontium, calcium, and magnesium), that is, with elements lying intermediate in chemical behaviour between the alkalies and ordinary metals; the form here approaches that of the elongated ellipsoid of rotation. With zinc, cadmium, and mercury, the form approximates to the flattened type of the rotation ellipsoid.

Perhaps the most striking consequence of the theory is that which follows from an alteration in the shape of one of the simple ellipsoids of rotation. Such a solid can be imagined as being gradually strained in such a way that it passes into the more general ellipsoid with unequal axes. During such deformation the spectral lines will gradually and continuously change, and the mathematical theory predicates that out of each single line eight others can arise. It appears, indeed, that the Zeemann effect, or the resolution of a single line into two or more other lines under the influence of a magnetic field, is explicable on this hypothesis. It may be observed that the normal triplet which should result according to Zeemann's simple theory does not, as a matter of fact, occur by any means frequently, the arrangement of the resolved lines having been shown by recent work to be of a more complex character than was originally supposed. Such a complexity finds a simple explanation in Prof. von Lindemann's theory of strain.

Two other types of solids in addition to those already mentioned are susceptible of mathematical treatment, namely, the solids derived by the rotation of a circle round an axis not passing through its centre. When the axis does not cut the circle a ring with a circular section is produced, such as an ordinary finger ring, which is open at the middle. When the axis cuts the circle, a solid, which Lindemann calls a "*Wulst*" or roll, and resembles in form an orange or an apple—is generated. A particle having the first of these shapes, when rendered luminous, would, according to the mathematical theory, give rise to lines having wave-lengths dependent on four numbers, to each of which a series of values can be given. The kind of spectrum which results can best be explained by imagining the spectrum due to a luminous particle of the elongated ellipsoidal type to be displaced several times in succession, the relative position of the lines being slightly modified in each shift. Such a spectrum has already been found to characterise oxygen and helium; the oxygen spectrum, indeed, according to Runge and Paschen, appears as if derived from that of an alkali metal by a series of successive displacements. An atom of the second type, with a shape similar to that of an apple, when rendered luminous, would, according to the calculations, give rise to a spectrum such as would be produced by successive displacements of the lines due to a flattened ellipsoid. The spectra of sulphur and selenium seem, indeed, to be of this type, being derived from a spectrum like that of oxygen by substituting single strong lines for certain groups of lines. The atom of oxygen thus appears to have the form of an open ring, the atom of sulphur or selenium that of a "Wulst."

Certain interesting consequences concerning the chemical properties of the elements follow from a consideration of their shape, and have been developed by Prof. Lindemann. That the ring-shaped oxygen atom, for example, is a dyad with regard to hydrogen at once follows from the plate-like shape of the hydrogen atoms, two of these being necessary to close the two apertures of the ring. A distinction, moreover, such as is actually found to exist, is introduced at the outset between valency with regard to hydrogen and valency with regard to oxygen. Apart from speculations of this kind, Prof. von Lindemann's work has great significance at the present moment, in that it demonstrates the possibility to derive those physical constants which most clearly define and characterise the individual elements from the conception of a single kind of matter merely by introducing the idea of shape. It is, of course, possible that the atoms do not possess strictly, but only approximately, the simple shapes which can be treated mathematically. If this were so, slight changes would be introduced into the transcendental equations, and the deduced values, for example those in the table given, can be considered only as a first approximation; but the approximation is sufficiently close to justify the belief that the general type of the transcendental equations is correct. W. A. D.

THE TIME OF FRANCE.

A NOTE from the Paris correspondent of a daily journal stating that the proposal to adopt Greenwich time in France is again being brought forward, a desirable reform which would bring our nearest neighbour into harmony in this respect with almost the whole of Europe, may be considered a sufficient reason for giving some facts on the subject under discussion.

Without going back to the earliest proposals for establishing a time-system which should be common to the whole world, an early stage in the movement was the calling of a conference by the Government of the United States to be held at Washington in October, 1884. At this meeting, which was attended by representatives of twenty-five nations, but who, it must be remembered, had no power to bind their Governments to any plan of action, it was resolved that "the Conference proposes to the Governments here represented, the adoption of the meridian passing through the centre of the transit instrument at the Observatory of Greenwich as the initial meridian for longitude." This resolution was voted for by representatives of twenty-two countries, one representative took the opposite view, and two countries, of whom France was one, abstained from voting.

Following on this, a resolution was passed at the meeting adopting the principle of a universal day which should begin at mean midnight of the initial meridian, a scheme containing the germ of the present hourly zone system. But a more practical step had already been taken by the managers of the American railways, who, in November, 1883, had adopted the now well-known system in which the American continent is divided into five zones, the time used in each of which is respectively 4, 5, 6, 7, and 8 hours slow on Greenwich. It says much for the breadth of view of the American railway managers, who thus rose above all consideration of national feeling and selected a zero which was likely to suit the convenience of the greatest number, and set an example which must have done much to forward the scheme.

Since 1884 there has been no open international intercourse on the subject, but gradually the zone time system has made its way. In 1892 Belgium and Holland began to use Greenwich time; in 1893 mid-European time, one hour fast on Greenwich, was made the legal standard time in Germany and Italy; in the next year the same time was adopted in Switzerland and Denmark, and in 1895 in Norway. Mid-European time had already been in use in Sweden many years, and on the Austrian, Hungarian, Servian, and Macedonian railways since 1891, but, strangely enough, Vienna, the home of Dr. Schram, who was one of the leaders of the movement for the unification of time, has not adopted any legal standard time. The meridian of Pulkowa happens to be 2 hours 1 minute east of Greenwich, and since the time of this meridian is used for telegraph work and on the railways of Russia, it may be considered that this country uses east European time, two hours fast on Greenwich, which is also used for some purposes in Turkey. Since Greenwich time was made the legal time of Spain in 1900, it will be seen that almost the whole of Europe has fallen in line. France has not held aloof for want of consideration of its merits. In 1896 the proposition that the Greenwich meridian should be adopted in France was brought by M. Deville before the Chamber of Deputies, and being voted on was accepted by that body, but the matter went no further, the reason for which may be inferred from the proceedings at the meeting of the Astronomical Society of France held on December 2, 1896. At that meeting several of the leading scientific men of France were present, and among them M. Bouquet de la Grye, who, after expressing his astonishment that scientific men had not been consulted before such a proposition was made, proceeded to raise objections. It was true, said he, that the meridian of Greenwich had been chosen as initial because of the greatness of England's sea-power; but, he asked, how long would this continue? England's supremacy in this respect might pass away just as had that of other nations, and what then?

Also he urged that Greenwich was too far north as a situation for an observatory to fix the standard meridian, and again, that the position of Greenwich with respect to the observatories of the Continent was not then accurately known. Another speaker, whose opinions are worthy of respect, remarked that France was not alone among the countries in not joining the movement, for Spain used its own time, and also—it is to be feared that here he made a strong point—Ireland, even, still used Dublin time. It was affirmed that the motives which influenced the French authorities in this matter were purely of a scientific nature, but it may be noted that since that meeting the proposition has been brought forward in other words, namely, that the legal standard time of France shall be 9 minutes 21 seconds slow on the time of the meridian of Paris, which is not unlike the former proposal, except verbally, and it might be thought that the alteration was made so as not to hurt some susceptibilities. However, the change has not yet been made. Some of the objections above quoted have vanished, for England's naval power has as yet suffered no reverse, Spain has adopted Greenwich time, and the difference of longitude between Greenwich and Paris has been again determined, with a result which may be accepted as final. Ireland still continues to use Dublin time, it is true, but even this ought not to outweigh any advantages that might accrue from the change.

H. P. H.

THE COLOMBIAN EARTHQUAKE.

ON January 31, we learn from vague messages, an earthquake of unusual severity occurred in the north-west part of South America. The report stated that towns and villages had been destroyed, and islands had sunk. The disappearance of the latter was, however, so gradual that the inhabitants had been able to escape in boats. Later information told us about the interruption of cables, and reported that in consequence of huge sea waves a long line of coast between Buenaventura and Tumaco and the western coast of the Republic of Colombia had been devastated for many leagues. A great catastrophe had evidently occurred, but until sixteen days later the East knew but little as to what had actually taken place. The seismographs in Britain and in other countries have, however, told a story. Later we shall have another story from our Consuls and our newspapers.

In the Isle of Wight the record of some great earth adjustment commenced, as reckoned in our time, at 3h. 47m. p.m. Its maximum occurred some thirty-five minutes later. From these facts the distance at which the mass displacement had originated was known, and by a simple computation, based upon this distance, the time at the origin would be in Colombian time approximately 10h. 9m. a.m. Better that the disturbance occurred in the morning, when heavings of the ground could be felt and high waves suggesting refuge on higher ground could be seen, than it should have occurred when the inhabitants of towns and villages on a seaboard were at rest. Two hours later the effects of the initial impulses had reached their antipodes, and in the interval between these times every inhabitant of the world had been moved for at least three or four hours on a true ground swell. All the instruments in the world designed to record teleseismic motion had written records, the bubble in every spirit level had been fitfully oscillating to and fro, many magnetic needles had been caused to swing, balances had oscillated, pendulums had been accelerated or retarded—the whole world, not only on its surface, but in its depths had been shaken. The internal constitution of our planet had been disturbed, that which is hypogenic may have produced its effect upon that which was epigenic, there was a flicker in the life-history of the earth.

At this moment it is not for us to enter into the whys and wherefores of the Colombian disaster. It suddenly came upon the scene in the last day of January, but it is not yet ended. Shocks continued for the next five days, and although we are without information, they will doubtless continue for many days to come. Among other things beyond these immediate effects on life and property, we learn that volcanic stress was relieved at Cumbal. Further, we learn that on February 16 severe shocks were experienced in the Antilles. At 1.40 p.m. on that date walls were cracked in St. Vincent; similar reports come from Fort de France, and cables have been broken.

History repeats itself, and this is particularly illustrated in the seismic and volcanic history of the Central American and West Indian subterranean activities. A convulsion in the one is followed by a reaction in the other. The last illustration, which is only one of a long series, occurred in 1902, when terrific readjustments of strata in Guatemala were quickly followed by the holocaust of St. Pierre. The Colombian disaster of January 31, to which we particularly refer, is the last of a series with which seismologists are familiar. We do not know for certain, but its origin was probably suboceanic off the mouth of the Esmeralda River. We can at least say that on the line we have indicated there is a rapidly descending suboceanic gully, and that cables crossing this line have frequently been interrupted. To this we may add that here we have a district where submerged land slopes are unusually steep, and where those who lay deep-sea cables tell us that soundings have from time to time been greatly changed. Out of fifteen cable interruptions which have taken place in the district under consideration, nine of them occurred at the time when seismographs or instruments which would record teleseismic effects were set in motion in Europe. Interruptions to cables come in many ways, but from time to time we know that they have come about by sudden changes in the form of ocean floors, and off the mouth of the Esmeralda River we know that this has often happened.

NOTES.

THE appointment of officers for the seventy-sixth meeting of the British Association, which is to be held at York, has now been completed. The meeting will open on Wednesday, August 1—when the president, Dr. E. Ray Lankester, F.R.S., will deliver the presidential address—and be concluded on August 8. The following are the names of the presidents of the various sections:—A (mathematical and physical science), Principal E. H. Griffiths, F.R.S.; B (chemistry), Prof. Wyndham Dunstan, F.R.S.; C (geology), Mr. G. W. Lamplugh, F.R.S.; D (zoology), Mr. J. J. Lister, F.R.S.; E (geography), Sir G. Taubman-Goldie, K.C.M.G., F.R.S.; F (economic science and statistics), Sir George S. Gibb; G (engineering), Prof. J. A. Ewing, F.R.S.; H (anthropology), Mr. E. Sidney Hartland; I (physiology), Prof. Francis Gotch, F.R.S.; K (botany), Prof. F. W. Oliver, F.R.S.; L (educational science), Prof. M. E. Sadler. Subscriptions to the amount of more than 700*l*. have been promised to the fund started for the purpose of founding a medal to commemorate the visit of the association to South

Africa last year. The council of the association has resolved to add to the fund the balance of the special funds raised to meet the expenses of the South Africa meeting, so that the total sum to be disposed of is between 1500*l.* and 1600*l.* It is proposed that the medal, struck in bronze, together with the balance of the income on the fund after paying for the medal, shall be awarded "for achievement and promise in scientific research in South Africa," and that, so far as circumstances shall allow, the award shall be made annually.

PROFS. F. KOHLRAUSCH AND A. A. MICHELSON have been elected honorary Fellows of the Physical Society of London.

AN International Exposition, in which discoveries and inventions relating to medicine and hygiene will have a prominent place, is to be held at Antwerp in April and May of the present year, under the patronage of H.R.H. the Countess of Flanders. Communications should be addressed to the secretary's office, 26 Rue d'Arenberg, Antwerp.

THE anniversary meeting of the Geological Society was held on February 16. Sir Archibald Geikie, Sec.R.S., was elected president. The medals and funds awarded, as announced already (p. 274), were presented. The president delivered his anniversary address, which dealt with the influence of the geological structure of English lakeland upon its present features—a study in physiography.

IT is stated in the *Globe* of February 17 that the first wireless telegraph station at Machrihanish, Argyllshire, is now completed, and communication has been commenced with other stations in Great Britain. The tower, which is 400 feet high, has been built to the order of the National Electric Signalling Company, of Pittsburg, by the Brown Horsting Company, New York. The diameter of the column is about 5 feet, and consists of pipe-shaped tubes, inside of which are the ladders for ascending.

THE Milan Chemical Society has appointed a committee to undertake the compilation of a catalogue of the Italian chemical industries.

AT the invitation of the committee appointed to consider the foundation of a Chemische Reichsanstalt, a meeting was to be held yesterday in the Aula of the University of Berlin to hear an account of the steps which have already been taken by the committee, and the reasons put forward for such a chemical institution.

BY a decree of the German Chancellor, an advisory committee of specialists is to be appointed to the Imperial Biological Institute for Agriculture and Forestry. The following appointments, amongst others, have now been made to this committee, and hold good until the end of 1910:—Prof. J. Behrens, Baden; Prof. Buchner, Berlin; Prof. Delbrück, Berlin; Prof. Gärtner, Jena; Prof. Gerlach, Bromberg; Dr. Hiltner, Munich; Prof. Hollrung, Halle; Prof. Kellner, Leipzig; Prof. Kirchner, Würtemberg; Prof. Ludwig Klein, Karlsruhe; Prof. A. Koch, Göttingen; Prof. Kühn, Halle; Prof. Möller, Eberswalde; Prof. P. Wagner, Darmstadt; Prof. Wortmann, Geisenheim. The director of the Imperial Institute for Agriculture and Forestry has been elected president of the advisory committee.

ON Thursday next, March 1, Mr. Francis Darwin will deliver the first of three lectures at the Royal Institution on the "Physiology of Plants," and on March 3 Prof. J. J. Thomson will commence a course of six lectures on "The Corpuscular Theory of Matter." The Friday evening discourse on March 2 will be delivered by Dr. R. Caton, the subject being "Hippocrates and the Newly Discovered Health Temple at Cos," and on March 9 by Dr. R. Hutchison, on "Some Dietetic Problems."

THE thirty-third annual dinner of old students of the Royal School of Mines was held on February 16. After the loyal toasts, the chairman, Prof. S. H. Cox, was asked to present to Prof. J. W. Judd a service of plate with an address and an album containing the signatures of 400 of his pupils and friends in all parts of the world as a mark of their esteem on his retirement from the office of dean of the school. In the address warm appreciation is expressed of Prof. Judd's services to geological science during his tenure of the chair of geology from 1877 to 1905, and the interest he invariably showed in the work and welfare of his students. Prof. Judd, in reply, alluded to the recently published report of the Government committee, which, he said, has outlined measures that will form a basis for the re-organisation of the school as a great and flourishing institution worthy of the Empire. The wants of a technical institution are not, he continued, identical with those of a university, either of the ancient or modern type, and it will be a calamity if the distinctive features of their school are lost by its being drawn into the vortex of a university. In proposing the toast of "The School," the chairman also alluded to the report of the departmental committee, and said those associated with the school are desirous of preserving its identity and the degree of Associate of the Royal School of Mines. They one and all dread being absorbed by a huge scientific institution, of which they will become only a subsidiary branch.

AT a meeting held at the Mansion House last June it was decided to commemorate the achievements of the late Sir Henry Bessemer by a memorial, which should have for its object some educational work so far-reaching in its beneficent influence as are the results of Bessemer's invention. The memorial committee deferred the active prosecution of the scheme until the publication of the report of the departmental committee on the work of the Royal College of Science, and, now that this report has been issued, it is possible to proceed actively with the memorial scheme. The committee is confident that no memorial could be more appropriate than one which has for its object the scientific advancement of the metallurgical and mining industries, and that none would be more likely to have met with Bessemer's warm approval. It has been arranged that the objects of the memorial fund shall be:—(1) The establishment of open international memorial scholarships for post-graduate practical work tenable (except such as it is intended to allocate to the Royal School of Mines, the Sheffield and Birmingham Universities, the Armstrong College, Newcastle-upon-Tyne, or other approved British institutions) in any part of the British Empire, in the United States of America, and in Europe. It is intended that these scholarships shall be of such value, and shall be awarded under such conditions, that they will be regarded by students of any nation as a prize worth striving for, and as an incentive to the highest scientific attainment. (2) The equipment of mining and metallurgical memorial laboratories in the Royal School of Mines at South Kensington as the centre of the memorial. The land and the cost of the new buildings and maintenance for the school will be provided from Government and other sources. (3) The erection of a statue of Bessemer in the new Royal School of Mines at South Kensington. Subscriptions amounting to about 8000*l.* have already been

received towards the large sum which will be required. Communications should be addressed to the Hon. Secretary, Bessemer Memorial Fund, Salisbury House, E.C., and all cheques should be made payable to the "Bessemer Memorial Fund," and crossed "Bank of England."

We have received from the Philosophical Institute of Canterbury, New Zealand, copies of four papers by the late Captain Hutton published in the *Transactions of the New Zealand Institute* for 1904. Their respective titles are:—"The Formation of the Canterbury Plains," "The Occurrence of *Graucalus melanops* in New Zealand," "Revision of New Zealand Tertiary Brachiopoda," and "Three New Tertiary Shells."

No. 8 of vol. ii. of the zoological section of the *Publications of the University of California* is devoted to the first paper of a memoir of the "Dinoflagellata" of the San Diego district, by Mr. C. A. Cofoid. It appears that investigations carried on during the last few years at the San Diego station have brought to light amid the "plankton" of the Pacific a number of species of flagellate animalcules which cannot be referred to any known genus, and for which the new name Heterodinium is proposed.

Recent issues of the *Proceedings of the Academy of Natural Sciences of Philadelphia* contain papers on the following subjects, viz.:—a collection of birds from British East Africa, by Mr. W. Stone; Hawaiian species of the molluscan genera Endodonta and Opeas, by Messrs. Pilsbry and Vanatta; Pacific Cerithiidæ, by the same authors; and notes on, and descriptions of, Costa Rican Orthopoda, by Prof. Rehn. In the last of these the author describes a very remarkable species of stick-insect of the family Phasmidæ, which is referred to the genus Olcyphides, Griffini, with the name of *O. viridipes*. This species, of which the figure is reproduced, is allied to Westwood's *O. venilia*, of Bogota, but differs in the shorter mesothorax and metathorax, and the much greater elongation of the abdomen and limbs, as well as in details of coloration and other points.

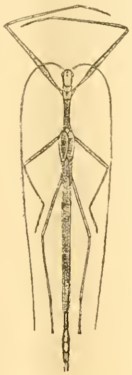


Fig. 1.—*Olcyphides viridipes*, from Costa Rica (½ natural size).

In the November (1905) issue of the *Nature-study Review* Miss A. M. Fielde gives an interesting illustrated account of the communal life-history of ants, primarily intended for the information and guide of those who keep these insects under observation in the cases invented by the author. There are, however, many observations of special interest. Among these is the statement that ants of different species—which always display deadly hostility to one another—can be trained to live together in friendship. Mr. C. W. Wild discusses the study of deciduous trees in winter; while Mr. M. A. Bigelow ridicules the theory that certain groups of plants develop tubers or bulbs in order to escape destruction by animals.

We have received from the author, Prof. F. Eulenburg, of the University of Leipzig, a copy of an article on society and nature ("Gesellschaft und Natur"), reprinted from the *Archiv fur Sozialwissenschaft und Socialpolitik* for 1905. The subject is treated, after some introductory considerations, from the following points of view:—(1) the determination of the objects of science, especially social science; (2) the importance and necessity of social laws; (3) the threefold relation of society to nature; (4) special problems; and (5) the relations of social science to biology and practical politics.

The felted beech coccus, *Cryptococcus fagi*, is the subject of a leaflet, No. 140, issued by the Board of Agriculture and Fisheries. The scale insects are provided with a long sucking tube by which they draw off the sap; they are stationary, and cover themselves with a white waxy secretion. The larvæ also drain the juices of the tree. Although the insects are conspicuous objects on the bark, and are principally found on the main trunk and larger branches, their waxy coverings shelter them effectively, and treatment with such insecticides as paraffin emulsion, Gillander's mixture, or caustic alkali wash must be thorough to prove efficacious.

In the *Indian Forester* (March, 1905) Mr. R. S. Pearson stated that he had obtained satisfactory results in the Panch Mahals, Bombay, in rearing young teak plants by subjecting the seed to a preliminary treatment in pits, in which layers of seed an inch deep were arranged alternately with layers of soil, and the pit was flooded with water every other day until germination commenced. This and other experiments with seed of *Anogeissus latifolia*, described in the November issue, appear to depend upon the maintenance of a regular and sufficient, but not excessive, supply of water. Another fairly successful method consists in subjecting the seed to a slight fire that produces artificially the effects of a light forest fire in a dry teak zone.

Among the contributions to the *Journal of the Royal Horticultural Society* (December, 1905), Dr. M. Cooke writes an article on the fungoid pests of forest trees; Mr. G. S. Boulger, dealing with the preservation of wild plants, adduces a number of specific instances of damage done by ruthless collection; and Mr. W. G. Freeman discusses a few of the important features of the West Indian fruit industry. The method of producing new potatoes out of season from old tubers, as described by Mr. J. J. Powell, is a valuable hint to private gardeners, the essential points being retardation and a variety that keeps well. Fruit growers will be interested in the publication of the report of the committee appointed to inquire into the fruit industry, and in the notes by Mr. T. E. Sedgwick on methods of fruit preserving.

The use of wood-pulp for paper-making was dealt with in a paper read by Mr. M. C. Phillips before the Society of Arts, and published in the Journal of the society last May. A machine for grinding wood into pulp was patented by Keller in 1844, but the modern method of making *mechanical* pulp has developed out of the machine constructed by Henry Voelter in 1858 that not only disintegrated but also assorted the fibre. The mechanical process is largely practised in Norway, Sweden, and Canada, and provides the bulk of journalistic paper. Better paper is produced by chemical processes in which the wood is treated with various chemicals that remove the ligneous and mineral constituents, leaving wood-cellulose. Tilghman (1857), Ekman, and Mitscherlich were the pioneers in this branch of the industry. The paper has been reprinted by the Government of India in connection with the experiment of producing wood-pulp in that country.

A BULLETIN on "The Mineral Constituents of the Soil Solution," by Messrs. F. K. Cameron and J. M. Bell, has been received from the U.S. Department of Agriculture (Division of Soils, Bulletin 30, 1905, pp. 70). This latest publication of the division over which Mr. Whitney presides deals with the problem that has been the subject of so much of the recent work on soils done by the United States Department of Agriculture—the composition of the solution formed by the water in the soil. It is generally recognised now that plants feed on this solution and are incapable of attacking the solid constituents of the soil, so that the composition and mode of origin of this solution must furnish the interpretation of many of the difficulties regarding the relationship of crops to soils. The Bulletin is more of a general discussion and a bibliography than a record of new investigations; it sets out a brief account of most of the work that has been done on such matters as the solubility of the minerals composing the soil, the hydrolysis and similar changes then taking place, adsorption and absorption by finely powdered materials, flocculation, surface reactions, and such other phenomena in the borderland of chemistry and physics as must play a leading part in the reactions going on in the soil. The main thesis of the Bulletin is that the soil materials hydrolyse and form a solution in equilibrium with the portion which remains solid; this position of equilibrium will be continually restored or maintained whenever it is temporarily disturbed, as by the addition of manures or the withdrawal of substances by growing plants. We fail to perceive, however, that all the parade of authorities lend any support to the extraordinary doctrine which the American official soil chemists seem to have adopted as an article of faith—that all soils, whatever their origin or treatment, yield the same soil solution, and therefore possess the same nutritive power. Putting aside this "conclusion," which is brought in at the end, though nothing particular seems to have led up to it, all workers in this field will be glad to possess the Bulletin as a guide to the scattered literature on a difficult subject.

WE have received from Mr. G. Henriksen, of Christiania, a translation of his pamphlet, written in Norwegian, on the iron-ore deposits of Sydvaranger, in Finmarken, Norway. Iron ore occurs in large quantities in gabbro. It consists exclusively of magnetite. The deposits are considered by the author to have been formed by the action of pressure on eruptive rocks.

IT is reported in the *Engineering and Mining Journal* (vol. lxxxi., No. 4) that great development has taken place in gem production in Brazil. Exploration in Minas Geraes has led to discoveries of tourmaline which have furnished red, blue, and green gems, and of beryls which have furnished magnificent blue and green stones. A large quantity of Brazilian amethyst has been obtained from the great geode, the bulk of which was shown at the Düsseldorf Exhibition in 1902.

UP to the present time the manufacture of chilled rolls has remained purely empirical; and a paper by Mr. E. de Loisy in the *Bulletin de la Société d'Encouragement* (vol. cvii., No. 10), describing his researches made to ascertain the scientific rules that should guide the iron-founder, is therefore well worthy of careful attention. For chilled rolls for rolling steel sheets or wire rods the composition sought should be as follows:—carbon, 2·9 to 3; silicon, 0·7 to 0·9; manganese, 0·5 to 1·0; and phosphorus, 0·35 to 0·45. The addition of steel scrap to pig-iron is recommended, but the proportion should not be much above 15 per cent. The author gives a large number of analyses of chilled rolls that have lasted well in the rolling-mill.

AN interesting note on prospecting in the Transbaikalian goldfields has been communicated by Mr. R. Farina to the Institution of Mining and Metallurgy (Bulletin No. 17). The district has long been famous for its gold placers. Platinum and cinnabar are also met with. The gold veins vary greatly in character. Those rich in gold are very porous, friable, and highly oxidised. The other veins are of the hard white quartz type. The best time for prospecting is March and April, when the snows have almost gone. The rocks of the country are chiefly quartz porphyry, granites, andesites, diorites, and gneiss. In a note, in the same Bulletin, on tin in Tringganu, on the east coast of the Malay Peninsula, Mr. C. G. Warnford Lock records the occurrence, in the alluvial tin fields, of monazite and xenotime in pot-holes in the granite beds of the streams.

THE *Journal of the Society of Chemical Industry* (vol. xxv., No. 2) contains an interesting paper by Mr. A. H. Hiorns on the effect of certain elements on the structure of cast iron. He gives a summary of previous researches on the subject, and describes some experiments made by himself with pure cast iron to which various proportions of silicon, manganese, phosphorus, and sulphur were added. He gives illustrations showing the appearance of polished and etched surfaces examined under the microscope. In the discussion, Mr. W. Rosenhain referred to the process of heat tinting in connection with the detection of the presence of phosphorus, and pointed out two very serious difficulties that had to be overcome before satisfactory results could be obtained. These were the difficulty of obtaining the surfaces in a perfectly clean state, and the fact that the actual surface very often did not represent the real structure of the metal, because the very act of polishing tended to spread the softer constituents over the harder, and in all cases produced a definite layer of altered material.

WE have received from Mr. G. T. Beilby a reprint, in pamphlet form, of his presidential address to the Glasgow University Engineering Society, delivered on January 11. In it he discusses, with a thorough mastery of his subject and with conspicuous literary skill, some of the wider aspects of modern power production for industrial purposes, more particularly with reference to the fuel resources of the country. He shows that the annual coal consumption of the United Kingdom is 167 million tons, the various channels of consumption being as follows, in millions of tons:—railways, 13; coasting steamers, 2; factories, 53; mines, 18; iron and steel industries, 28; other metals and minerals, 1; brick-works, potteries, glass-works, and chemical works, 5; gas works, 15; and domestic, 32. Taking the consumption of coal for power purposes at mines and factories as 52 million tons, a saving of some 42 million tons could be realised with time and enterprise. There are in Great Britain steam engines and boilers with a yearly output of at least 5 million horse-power. The coal consumed by these is not less than 5 lb. per indicated horse-power hour, or on the whole 40 million tons. By the use of gas engines and steam turbines the coal consumption might be reduced to 1½ lb. per indicated horse-power hour, or on the whole to 12 million tons. The saving in coal, therefore, is equal to 28 million tons, valued at 9,800,000*l*. The cost of making the change need not exceed 50,000,000*l*., or, if the power is to be delivered as electricity, 60,000,000*l*. The saving in

the coal bill is equivalent to a return of 16·3 per cent. on the higher capital expenditure. In these estimates no credit has been taken for the reduction in working costs which would result from the installation of more efficient plant. In many cases this would amount to as much as the saving on coal.

ACCORDING to the *Teknisk Tidskrift*, the development of the Swedish chemical industries last year was but slight, but the following points may be noticed:—the manufacture of beet sugar has been pushed further north by the opening of a sugar factory at Linköping; the preparation of "peat spirit" has been a subject of wide and searching discussion; the increased uses of acetylene and of acetylene-acetone solutions, and the process of welding with acetylene, have much favoured the carbide industry; the manufacture of paper from wood has improved both quantitatively and qualitatively; great strides are said to have been made in electrochemical industries; much attention has been given to improving methods of producing pig-iron—a number of Gröndal, American, and newer native type combustion furnaces have been built or arranged for; in the manufacture of steel we are told that several innovations and changes have been witnessed, though no official statistics are yet available for comparisons with previous years—but it is to be noted that the Bessemer process is gradually yielding to the Martin method; an experimental electrical steel furnace has been arranged at Nykroppa; many works have introduced Bildt's method of heating boilers with generator gas; suction gas plants, combustion and petrol motors, and steam turbines have risen in popularity.

IN connection with the shortage of rainfall for 1905 in the British Isles, it is interesting to note the state of affairs at the antipodes. With regard to the rainfall of South Australia, Sir Charles Todd states that throughout the whole of the Northern Territory, the interior of the continent, the pastoral country to the northwards, and as far south over the more settled districts as Petersburg, the total rainfall of the year failed to reach the average. The summer season (November, 1904, to March, 1905) was, on the whole, dry all through the settled districts and most of the pastoral country, many stations in the southern areas having only about half the annual supply. The total for the agricultural season (April to October) was, however, generally in excess of the normal fall for this period, from Wilmington and Petersburg southwards, but north of these stations it was rather below the average.

THE construction of magic squares is a recreation which has diverted even such minds as those of Euler and Fermat; with kindred problems it still maintains its popularity. Frost extended the notion to three dimensions, and wrote a paper on "nasik cubes" (*Quart. Journ.*, 1878); in "The Theory of Path Nasiks" (Rugby: Lawrence) Mr. C. Planck has quite recently developed Frost's theory, and given several examples. His method involves the solution of sets of simultaneous linear congruences, and he considers the problem in n dimensions.

IN No. 5, vol. xxii., of the *Astrophysical Journal*, Mr. R. E. Loving, of the Johns Hopkins University, publishes the results of an interesting research concerning the nature and action of the metallic arc in high vacua. Having previously proved that the spectrum was characteristic of the anode only, he employed various metals as anodes in conjunction with the same platinum kathode, and on photographing the more refrangible end of the spectrum found that it was not similar to either the ordinary arc or spark spectra, but was much more like the latter than the former. The relative intensities of the lines obtained did not agree with the spark intensities or with those observed for the same lines in the chromosphere. Mr. Loving gives a tabular statement in which the relative intensities of magnesium, calcium, chromium, manganese, titanium, and iron lines in the ordinary arc and spark, the chromosphere and the arc in vacuum are compared. Other important points regarding the mechanical action of the discharge, the action of a magnetic field, and the luminosity of the anode are dealt with in Mr. Loving's paper. Brief reference might be made here to one peculiar result. The violent kathode discharge was found to have a marked deteriorating action on the glass of the tube. After being used for several days the glass was found to crack much more readily when put into a flame, and the fragments were so friable that they could easily be broken between the fingers.

MR. JOHN GOLDING AND DR. FEILMANN direct attention to a peculiar mealy flavour which occasionally develops in milk (*Journ. Soc. of Chem. Industry*, December 30, 1905). Experiments showed that copper is acted upon by milk, especially in the presence of air, and that small quantities go into solution in the milk (from 1 part to more than 100 parts per million). Fresh milk when thus contaminated is very liable to the development of a peculiar mealy flavour in sixteen to eighteen hours. This flavour seems to be due in part to the development of micro-organisms in the presence of copper, which both checks the development of the lactic organisms and plays a more direct part in the actual development of the flavour.

COLONEL FIRTH AND DR. MACFADYEN contribute to the *Journal of the Royal Sanitary Institute* (xxvii., No. 1) a record of experiments made on behalf of the Disinfectant Standardisation Committee from which they consider that the "drop" method of Messrs. Rideal and Walker is the most practical and accurate method yet devised for the testing and comparison of disinfectants, and make some valuable suggestions for carrying it out. Profs. Kenwood and Hewlett also contribute a paper on the standardisation of disinfectants, in which they show the variations which may obtain in practice and the modifying effect of organic matter on germicidal power, and urge that a large margin of safety should be allowed for all disinfectants.

THE *Journal of the Röntgen Society* (December, 1905) contains an interesting paper by Mr. Butler Burke on the action of radium and other bodies on gelatin, and the production of the so-called "radiobes," which have some likeness to micro-organisms. At first these look like mere air-bubbles, but in course of time they expand or grow, appear to contain a nuclear structure, but in the course of a fortnight or so begin to break up, and later on disappear. They are also soluble in warm water and varnish at a temperature of 35° C. Mr. Burke expresses the opinion that they are on the border-line between crystalline and organic bodies, that they cannot properly be called living, but correspond possibly to some simple form of life that existed in a far distant age.

UNDER the title of "La Fin de la Matière," Prof. H. Poincaré gives in the *Athenaeum* for February 17 a brief *résumé* of recent views of the ultimate nature of matter. The essential purpose of Prof. Poincaré's article is to define how far the idea of mass or inertia has been compromised by the results of Abraham and Kaufmann, by the speculations of Lorentz, and by the doctrine of

electrons. Prof. Poincaré is careful to emphasise the assumptions on which recent views are based, but if the assumptions are correct the final result consists in stripping from matter the attribute of mass by which it is usually defined. Mass appears purely as the result of electrical action, or, in Prof. Poincaré's own striking words, "dans ce système il n'y a pas de vraie matière, il n'y a plus que des trous dans l'éther."

SOME time ago Prof. Nernst described a simple form of torsion balance capable of measuring weights of a few milligrams with an accuracy of 0·001 milligram. In the current number of the *Berichte* Mr. H. v. Wartenberg gives an interesting application of this instrument to the determination of the molecular weight of silver vapour. The method used was a modification of the well known apparatus due to Victor Meyer, the vessel being made of iridium, coated internally with a mixture of the oxides of yttrium and zirconium. This iridium vessel was heated in an electric furnace to about 2000° C., the weight of silver used in each experiment varying from 0·905 to 0·322 milligram. The values obtained for the molecular weight of the silver were between 107 and 147, indicating that silver is monatomic.

MESSRS. DAWBARN AND WARD, LTD., have published in their "Home Worker's" series a little book by Mr. Joseph E. Dangerfield on "Brass and Iron Founding." The price is 1*s.* 6*d.* net.

THE "Swincam" camera stand enables a camera to be fixed on the tripod in almost any position, so that photographs can be taken in situations which present insurmountable difficulties with ordinary stands. A revised pamphlet showing some of the possibilities and performances of this speciality in tripod stands has been issued by the maker, Mr. W. Butler, Southport.

MESSRS. WHITTAKER AND CO. have published a second edition of Mr. S. R. Bottone's "Radiography and the 'X' Rays." The book was reviewed in our issue of July 28, 1898 (vol. lviii. p. 292); and it is only necessary to say here that recent improvements in Röntgen-ray apparatus, and interesting matter connected with the therapeutic effects of the rays, are dealt with in the new edition.

OUR ASTRONOMICAL COLUMN.

COMET 1906*a*.—The following is taken from a continuation of the daily ephemeris for comet 1906*a* (Brooks), published by Herr M. Ebell in No. 4075 of the *Astronomische Nachrichten*:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
Feb. 22	6 45 35	+78 30	0·2047	0·0024	0·82
24	6 21 29	+75 12	0·2094	0·0150	0·76
26	6 7 28	+71 59	0·2140	0·0288	0·69
28	5 58 38	+68 55	0·2187	0·0435	0·64
Mar. 2	5 52 47	+66 1	0·2234	0·0589	0·58
4	5 48 50	+63 19	0·2282	0·0748	0·53

It will be seen from the above that the comet is now travelling rapidly down the constellation Camelus towards Perseus, and is becoming much fainter.

A set of parabolic elements of the orbit of this object has been computed by M. E. Maubant, and appears in No. 6 (1906) of the *Comptes rendus*.

COMET 1905*c*.—Photographs of Giacobini's comet (1905*c*) obtained at Greenwich early in January showed that the magnitude was about 3·0, and that this object had a tail about 2° in length.

A note in the February number of the *Bulletin de la Société astronomique de France* quotes M. Giacobini, who, in a letter to a correspondent, stated that the comet was visible to the naked eye during the whole week preceding January 9, and that it then had a tail about 1° in length, the position angle of which was 45°. The nucleus was estimated as being of the second or third magnitude. The nearest approaches of this object to the earth took place on January 6 and February 2, the respective distances being 1·102 and 1·150 astronomical units. Its distance from the sun at perihelion was 0·2154 unit.

THE APPARENT ENLARGEMENT OF THE MOON AT THE HORIZON.—In the *Archives de Psychologie* (vol. v., No. 18, October, 1905) M. Ed. Claparède publishes an interesting paper on the causes which produce the impression that the sun, moon, and other celestial bodies are larger when near to the horizon than when seen at the zenith.

After discussing a number of theories propounded by previous writers on this subject, from Aristotle onwards, he examines several possible causes, and recounts the results of various experiments he has made whilst considering the matter.

Finally, he arrives at the conclusion that when we see the moon, or sun, at the horizon, we are surprised into believing it to belong to things terrestrial—to come into the class of objects which are by far of the greatest interest to us. As such we notice it with much greater attention,

and for this reason overestimate its size. When at the zenith the moon is of little interest in comparison with the terrestrial objects which belong to our daily life, and we therefore think of it as relatively unimportant; consequently we underestimate its size. This correlation of importance and size is always common, and, as an illustration of it, M. Claparède quotes the fact that boys are always astonished when they learn for the first time that Napoleon was below the average height.

M. Claparède used the illustration we reproduce, in his experiments with individuals. Covering one of the moons shown, he asked his subjects to draw the other one the same size, and then asked them to draw the second whilst the first was covered. Of twenty couples of drawings thus obtained, from thirteen subjects of all ages, the moon at the horizon was shown as the greater on fourteen, as equal on five, and as less on one. The greatest difference was shown on two drawings by the same boy, where the moon was 9 mm. (horizon) and 4·5 mm. (raised) respectively, the actual diameter on the copy being 4·5 mm.

M. Claparède's paper may be obtained, as a separate brochure, from MM. Kündig et Fils, Geneva, price 1 franc.

MAGNETIC OBSERVATIONS DURING THE TOTAL ECLIPSE OF THE SUN.—We have received from Father P. Cirera, of the l'Ebre Observatory, an extract from the *Comptes rendus* giving an account of the magnetic records obtained at

that observatory during the total solar eclipse of August 30, 1905, and the days immediately preceding and following it.

Extraordinary deviations from the normal diurnal curves were registered in all three elements, and these are plainly shown on the photographic copy of the records which accompanies Father Cirera's communication.

OBSERVATIONS OF JUPITER.—Major Molesworth's report of his observations of Jupiter, made at Trincomali, Ceylon, during 1904–5, appears in No. 3, vol. lxvi., of the *Monthly Notices R.A.S.*, and records the times of rotation of, and the changes in, most of the Jovian features.

One especially remarkable observation was that the following and preceding ends of the large mass of dark matter, known as the Great S. Tropical Dark Area, appeared, on comparing the observations, to have crossed the whole Red Spot bay simultaneously. As it seems impossible that there could be any such instantaneous transference of material, Major Molesworth explains the phenomenon by the suggestion that the movement of the dark area into the belt following the bay caused the extrusion of an equal amount of dark material from the belt preceding the bay.

GRANULATIONS ON THE SOLAR SURFACE.[1]

AN interesting research which promises fair to lead us to an increased knowledge concerning the nature of the sun's photosphere has recently been instituted by Prof. Hansky at the Pulkowa Observatory. On examining the splendid collection of photographs of the solar surface obtained by Prof. Janssen at Meudon, Prof. Hansky was not able to satisfy himself that the whole of the *réseau* seen on the negative was actually of solar origin; it seemed probable that some parts of it were produced by waves in our atmosphere, and on no two consecutive negatives, nor even on two taken simultaneously, could the same granules be recognised. For this reason he attacked the problem at Pulkowa, bringing into operation the astrographic telescope in order to obtain photographs on a large scale.

The solar image at the focus of this instrument has a diameter of 3 cm., which by the use of a concave lens was increased to about 54 cm. (*i.e.* 21·3 inches). With this apparatus numerous photographs were obtained during May and June, 1905, and showed many of the finer details of the granulations which cover the solar surface; but even on this scale it was impossible to recognise the same features on successive photographs. A further improvement was then made, so that the intervals between the exposures might be appreciably shortened—in no case had it been less than five minutes—and with the new arrangement adapted to the astrograph it became possible to take eight consecutive photographs with intervals of fifteen to thirty seconds' duration. These showed the changes taking place in the sizes and relative positions of the granules very plainly, and from them the author has chosen six for reproduction in his circular. Fig. 1 is a copy of one of these reproductions, and shows the general nature of the photographs which Prof. Hansky is obtaining, and from which he hopes to derive valuable results. The scale is such that the solar diameter would measure about 0·6 m., or 23·5 inches. The large black portions represent parts of sun-spots which came within the region photographed.

Although on this scale obvious changes in the size and arrangement of the granules took place in twenty-five seconds, it was impossible to measure their magnitude, so Prof. Hansky intensified the photographs by successive copying, and finally obtained positives showing portions of the disc on such a scale that the length of the solar diameter would be about 6 m. (19·7 feet), that is to say, 1 mm. $=0''\cdot32$, or 233 km. on the solar surface.

An examination of these positives showed that the primary desideratum had been attained; the same granules were recognisable on successive photographs, and the scale was large enough to enable measurements of the granules themselves and of their movements to be made. The displacements were measured with the stereo-comparator, and were referred to a neighbouring small spot, movement towards the spot being indicated by the negative, and away from the spot by the positive, sign. The diameter of the actual sun was taken as 1,400,000 km., and on June 21 this gave $1''=740$ km. The mean variation of any two settings on the same object was $\pm 0''\cdot 12$, and the probable error for the relative displacement $\pm 0''\cdot 10$.

The displacements of the granules during the twenty-five seconds which elapsed between two successive photographs taken on June 25 were very diverse. In that interval five of the granules had moved $-0''\cdot 9$, $-0''\cdot 55$, $-0''\cdot 77$, $-0''\cdot 48$,

FIG. 1.—June 25, 1905, 5h. 6m. 20s.

and $-0''\cdot 80$ respectively, which in the mean gave $-0''\cdot 70$, or -518 km., *i.e.* about -21 km. per second. Another group gave -38 km. per second, whilst for a third the comparatively low velocity of -14 km. per second was recorded.

Comparisons of other photographs showed that some granules were moving away from the spot with various velocities, and, as shown by the following figures, it appeared that the periodic movement of the granules materially affected the size of the spot. The diameter of the spot is given for different times on June 25:—

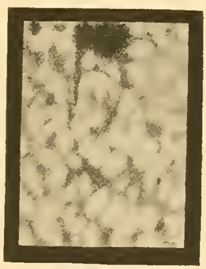


FIG. 2.—June 25, 1905, 4h. 17m. 15s.

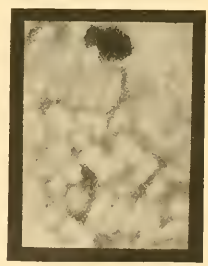


FIG. 3.—June 25, 1905, 4h. 17m. 40s.

4h. 17m. 15s., $2''\cdot 64$; 4h. 17m. 40s., $2''\cdot 25$; 5h. 3m. 15s., $3''\cdot 03$; 5h. 4m. 15s., $1''\cdot 35$; 5h. 5m. 50s., $2''\cdot 70$; 5h. 6m. 20s., $2''\cdot 88$.

On consecutive photographs taken with an interval of one minute the same granulation was recognised with difficulty, whilst with a three-minute interval the whole *réseau* was practically re-arranged beyond recognition, although in one or two cases it was possible to trace a granule after this interval, and in two cases it was remarked that gemination had taken place.

The dimensions of the granules varied greatly between

[1] "Photographies de la Granulation solaire faites à Poulkowa." By A. Hansky.

670 km. and 2000 km., the mean diameter being 1″·9, or about 1400 km. Figs. 2 and 3 illustrate the type of photograph on which the measures were made. These were taken with an interval of twenty-five seconds, and even a cursory glance will show that during that time the arrangement and forms of the granules have altered considerably; on this scale the diameter of the sun would be about 3 metres.

It seems probable that these researches will lead to most important conclusions concerning the nature and the periodicity of the changes in the granules themselves, their influence on the solar spots and faculæ, and, in general, to the resolution of many outstanding problems concerning the nature and action of the photosphere, which are at present unsolved. Prof. Hansky intends, therefore, to pursue this line of research, but, as he points out, it will cnly be during the comparatively rare moments of atmospheric calm, and with such a powerful equipment as he now possesses, that fruitful results are likely to be obtained. In any case, he is to be warmly congratulated upon those he has already published.

W. E. ROLSTON.

PRACTICAL SCIENCE FOR SCHOOLS.[1]

PROF. PERRY said that in the early days of the society, when he had the honour of acting as a secretary, and when Guthrie and Foster, Kelvin and Fitzgerald were presidents, no presidential addresses were delivered, and he questioned whether we were not overdoing the business of requiring general addresses, which must almost always have as their theme the progress of science. Seldom did we find in such addresses new accounts of important original work, and he felt the inappropriateness of such an address in speaking before a society the Proceedings of which were more intense with original work of the best kind than any other society known to him with the exception of the Royal Society. He thought that every young reader of a paper before a scientific society made the mistake of assuming that his audience knew a great deal of the subject so familiar to himself, and hence his paper was not understood. Writers of books on physics assume their readers to be all truly logical students; they use words properly in a technical sense, and forget that many of their readers may use them in the newspaper writer's sense. For example, take the expression "adiabatic expansion." There are people who insist on finding that Rankine, Maxwell, and all others of our most exact writers are not only inconsistent with one another in the use of the expression, but that each is inconsistent with himself. If a portion of fluid expands slowly without gain or loss of heat, we know the way in which its p, v, and t alter as it changes state; this was originally called "adiabatic expansion," and the term has become a technical term for that kind of alteration of p, v, and t, however it may occur. Steam or air may be throttled through a non-conducting reducing valve, but the expansion is not adiabatic, although there is no gain or loss of heat. Steam or air passing along a pipe with friction, if it can only be made to lose heat through the metal of the pipe at exactly the proper rate at every place, is expanding adiabatically. When it is assumed that steam or air flows without friction from a vessel through an orifice, it is said that the expansion is adiabatic although it is rapid.

Referring to the teaching of physics to students entering upon the engineering profession, the president remarked that such teaching was nearly always slipshod. Many men enter a science college at the age of eighteen or more, knowing nothing of physical science. In the case of a great percentage of such men, it is impossible that they should acquire the scientific habit of thought. It is because so much of this kind of material is dealt with that much of our teaching is slipshod. Every pupil entering a science college ought to have been experimenting and working graphically and numerically on physical science problems from a very early age, and then our science classes would deal with them in a scientific way. The causes of the unfitness of the average student are two: one that his instincts and habits of thought were not trained from early youth; the other that his teachers in science colleges have absurd and uninteresting courses of study for him. In physics we are dealing with ideas which are not familiar to young students, ideas which can only become familiar in the laboratory. For example, such a simple mathematical idea as that of a decimal cannot be given in elementary schools in less than five or six years, whereas one week of weighing and measuring would give young children familiarity and clear ideas about decimals. Numerous examples could be given to prove that the principles of physics cannot be understood unless there has been early experimental training, and this is the reason why the professors of science in colleges of university rank and the professors in technical colleges obtain such poor reward for their labour. Referring to the many hundreds who every year take science degrees at the universities, and the thousands who pass the London University matriculation examination, Prof. Perry remarked that if that was the standard of excellence of those present, his address could serve no useful purpose. Nothing ought to be compulsory in schools except the study of English and of natural science. The object of a matriculation examination is to test whether a student entering a college will be able to benefit by the course of study there. The only language which ought to be compulsory in the science department of a university is English. A professor of science ought to be allowed to teach his students in the way that seems best to him, and he should examine his students himself. Hedge him round with rules and regulations framed by boards of studies; tie him down to a syllabus, and the work he will do might be much better, certainly much more cheaply, done by a grinder at low wages. There is no one general elementary course in physics which all students ought to take; neither by their previous training nor from the uses which they will make of the principles of physics are they fit to be taught together. What is wanted is more classes, more rooms, and more teachers.

[1] Abstract of the presidential address delivered before the Physical Society on February 9, by Prof. J. Perry, F.R.S.

THE NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION.

THE New Orleans meeting of the American Association for the Advancement of Science, as stated in our issue for January 25 (p. 303), began on December 29, 1905, and continued for five days. At a meeting of the general committee it was decided to hold a special summer meeting at Ithaca, New York, to close on or before July 3, 1906, and an ordinary winter meeting in New York City to begin on December 27, 1906. The presidential and vice-presidential addresses will be omitted at the summer meeting and given at the winter meeting. The officers elected at the New Orleans meeting will, therefore, hold office until the close of the New York meeting. Chicago was recommended as the place of the winter meeting of 1907.

The following officers were elected for the Ithaca and New York meetings:—President: Dr. W. H. Welch, Baltimore, Md. Presidents of sections: A, Dr. Edward Kasner, New York City; B, Prof. W. C. Sabine, Cambridge, Mass.; C, Mr. Clifford Richardson, New York City; D, Mr. W. R. Warner, Cleveland, O.; E, Prof. A. C. Lane, Lansing, Mich.; F, Prof. E. G. Conklin, Philadelphia, Pa.; G, Dr. D. T. MacDougall, Washington, D.C.; H, Prof. Hugo Münsterberg, Cambridge, Mass.; I, Mr. Chas. A. Conant, New York City; K, Dr. Simon Flexner, New York City. General secretary: Mr. John F. Hayford, Washington, D.C. Secretary of council: President F. W. McNair, Houghton, Mich.

The following resolutions were adopted by the association:—(1) That the association instructs its president and secretary to communicate to the president of the Senate and to the speaker of the House of Representatives of the United States its strong conviction that Niagara Falls should be preserved as a natural wonder, and further expressing the earnest hope that the congress now in session will take prompt and energetic action looking toward an international consideration of the impending danger to Niagara Falls. (2) *An Appalachian Forest Reserve.*—That the association again respectfully calls attention to the rapid rate at which the forests of the

Appalachian Mountain region are being destroyed, and to the fact that, as a result of such destruction, the streams tributary to the Mississippi, as well as those flowing into the South Atlantic, are becoming continuously more irregular in their flow, and hence of less value for navigation and power purposes. (3) That the association respectfully petitions the Congress of the United States to make such provision as may be necessary for the protection of these mountain forests.

The following grants were made at this meeting of the association:—40*l.* to Messrs. Parsons, Kinnicutt, and Venable to assist in the publication of Prof. Parsons's "Bibliography of Beryllium," and 20*l.* to "The Concilium Bibliographicum Zoologicum."

The committee on electrochemistry reported as follows:—A study has been made of the behaviour of platinum and iridium in chlorine water and in dilute hydrochloric acid. Smooth platinum foil brought about no evolution of gas even after standing 168 hours in chlorine water. In precisely similar circumstances an iridium foil caused an evolution of 44·4 [? c.c.] of gas, 55 per cent. of which was oxygen. The oxygen results from the reaction

$$Cl_2+H_2O=2HCl+O,$$

while the chlorine came from the solution, the original vapour pressure having been about half an atmosphere. This series of experiments showed that iridium was a more powerful catalytic agent than platinum. A number of electrolytic experiments were made with hydrochloric acid of different concentrations. In all cases more oxygen was evolved from the iridium anode than from the platinum anode. The question as to the final equilibrium is still in doubt.

The Popular Conception of the Scientific Man at the Present Day.[1]

The traditional scientific man has disappeared almost as completely as the traditional Yankee of the stage. The change came gradually, but the proof that it had come was brought before us suddenly. In 1902 there was called in New York a meeting of those who were designated by the picturesque expression captains of industry. To that meeting representatives of science were invited, not as lions to be stared at, but to sit with the leaders of the industrial and commercial world as representatives of science, and not only of applied science, but of pure science. As the captains of industry were supposed to be men of force in organising and to have a keen insight into men and things, we had a right to feel that science was honoured, perhaps not more than ever before, but for a reason for which it had not been honoured before in the United States. The fact that since that date the reputation of some of the captains of industry has suffered an eclipse does not alter the fact that to be considered a captain of industry was, in the eyes of the public, enviable. The conception of a scientific man as a captain of industry means simply the acknowledgment that science has a practical relation to the world, and that fortunately the public have advanced far enough to see, although perhaps somewhat dimly, that pure science sooner or later develops into applied science. The leaders of science are to be placed in the class of organisers, managers of a sort of scientific trust. This is science up to date, and the public are right when they regard science as an organisation. But they are only partly right. There is a good deal more than that in science, and, although good managers and directors are necessary, it is true that the power of organising and the power of investigating are two different things, and often exist in inverse ratio to each other, and it is the latter which is at the basis of science. An organiser is of no use until there is something to organise, and the materials on which the organiser in science must work are not made by machinery, but by the brains of individual workers, and it is important that they should be placed under the most favourable conditions for work. If hitherto there has been perhaps too little organisation, there is a danger that in the future there may be too much. In a mill many men are doing the same kind of work, but in science one man should not duplicate the work of another. The object of organisation in the one case is to secure uniformity of product, in the other to encourage diversity of work.

The ways in which the public may aid scientific men are directly by endowments for paying salaries and indirectly by providing properly equipped laboratories and other necessary equipment, and especially for paying for the services of assistants. Both forms of help are necessary, for a man capable of managing and getting the greatest amount of good work out of a well equipped establishment deserves more than a meagre salary. On the other hand, those with what appears to be a respectable salary may have to spend a good part of it to make good the deficiencies in their equipment. In deciding whether a man is well paid or not, it is necessary to ask not only what salary he receives, but what are the means of work provided for him. It is not my intention here to direct attention to the special ways in which scientific establishments would be benefited by gifts from the public nor to discuss the question what is a proper salary for a scientific man. The latter depends upon too many complicated conditions, and cannot be separated from the more general question of what those in equally important positions in other walks of life are paid. The question of proper equipment, including the question of assistants, has already been brought before the public on a good many occasions and in a good many ways, and a good deal has been given in recent years, although by no means enough.

If, as it appears, the public have reached a better conception of the position of the scientific man and of his pecuniary needs, it may be added that he has the right to hope that he can appeal to the public not only for pecuniary, but for moral support, for, in many cases, the public are the final arbiters where differences arise, and unfavourable conditions often disappear quickly as soon as it is felt that one side or the other is backed by public opinion. It may, therefore, be well to state somewhat explicitly some of the conditions which are unfavourable to the progress of science in the United States or which tend to retard it. Here it is not so much a question of money as of a just appreciation of the true position of scientific men in their relation to those for whom their work is undertaken. That work, using a rough classification, may be considered as that done in technical and commercial concerns, that done for the Government, and that done in universities, including under that general term all colleges, scientific schools, and similar institutions which have a permanent endowment of some kind.

[1] From the address of Prof. W. G. Farlow, president of the Association.

The Relation of Mechanics to Physics.[1]

We find the physicists of the beginning of the nineteenth century still very strongly attached to the idea that all natural phenomena not only may, but must, be explained on the basis of Newton's laws[2] by central forces acting instantaneously at a distance. Newton's mechanics had done such admirable service in astronomy that it had come to be regarded as the only possible means of describing and discussing the actions of nature. The gradual abandonment of this position and the change to the modern view, according to which all actions in nature are transmitted through a continuous medium and require time for their transmission, was accomplished only after a long struggle that occupied the greater part of the nineteenth century.

It is well known how the ideas of Faraday, of Maxwell, of Hertz, gradually gained ascendency over the older views and led to the abandonment of the idea of central forces acting instantaneously at a distance, in almost all branches of physics except in the theory of gravitation. It is also known that Maxwell, by a brilliant analysis, succeeded in establishing the connection between his electromagnetic theory and the analytical mechanics of Lagrange. Thus, at the end of the nineteenth century we find a general attitude toward physical phenomena essentially different from that prevailing at the end of the eighteenth century.

With the rise of the electron theory in the course of the last twenty-five years a new element has been introduced

[1] From the address of Prof. Alexander Ziwet, president of Section A, Mathematics and Astronomy.

[2] See, however, Laplace, "Mécanique Céleste," livre i., chap. vi. ("Œuvres," vol. i., 1878, pp. 74-79), a passage to which E. and F. Cosserat have recently directed attention.

into this development, an element which seems destined to affect very radically, not only our interpretation of physical phenomena, but also our general views about the principles of theoretical mechanics.

There seem to be two things underlying all the phenomena in the physical world—the ether and matter. To attain the unification of physical science, shall we consider the ether as a particular kind of matter? Or shall matter be interpreted electromagnetically? The older mechanics dealt exclusively with matter; and when it first became necessary to introduce the ether, this new medium was often endowed with properties very much like those of matter. The hydrodynamic analogy by which the apparent mass of the moving charge was interpreted illustrates this tendency. The physics of the ether has, however, reached so full a development that the properties of the ether are now known far more definitely than those of matter. These properties are contained implicitly in the fundamental equations of Maxwell and Hertz which in their essential features are adopted in the electron theory of Lorentz.

It is now pretty generally recognised that Newton's "laws of motion," including his definition of "force," are not unalterable laws of thought, but merely arbitrary postulates assumed for the purpose of interpreting natural phenomena in the most simple and adequate manner. Unfortunately, nature is not very simple. "As the eye of the night-owl is to the light of the sun, so is our mind to the most common phenomena of nature," says Aristotle. And if since Newton's time we have made some progress in the knowledge of physics, it is but reasonable to conclude that the postulates which appeared most simple and adequate two hundred years ago cannot be regarded as such at the present time.

This does not mean, of course, that the mechanics of Newton has lost its value. The case is somewhat parallel to that of the postulates of geometry. Just as the abandonment of one or the other of the postulates of Euclidean geometry leads to a more general geometry which contains the old geometry as a particular, or limiting, case, so the abandonment or generalisation of some of the postulates of the older mechanics must lead to a more general mechanics. The creation of such a generalised mechanics is a task for the immediate future. It is perhaps too early to say at present what form this new non-Newtonian mechanics will ultimately assume. Generalisation is always possible in a variety of ways. In the present case, the object should be to arrive at a mechanics, on the one hand sufficiently general for the electron theory, on the other such as to include the Newtonian mechanics as a special case.

After the searching criticism to which Poincaré, especially in his St. Louis address,[1] in 1904, has subjected the foundations of mechanics and mathematical physics, almost the only one of the fundamental principles that appears to remain intact is the principle of least action. It seems, therefore, natural to take this principle as the starting point for a common foundation of mathematical physics and of a generalised mechanics, but with a broader definition of "action," or what amounts to the same, with a generalised conception of "mass" so as to make the latter a function of the velocity.

The Partition of Energy.[2]

The general theorem which I wish to discuss may be stated by saying that the kinetic energy of the body is so distributed among the degrees of freedom, by which the state of the body as a dynamical system is described, that an equal share is, on the average, allotted to each degree of freedom of each type of molecule.

The questions which have always been raised about this important theorem of the kinetic theory at once come to our minds. First, is the theorem true, or rather, does it state what would be true for an ideal system of particles moving freely within a containing vessel? second, is the proof of the theorem impeccable? third, is there any experimental evidence that it applies to real bodies?

[1] "Bulletin des sciences mathématiques" (2), 28, pp. 302–324; English translation in the *Bulletin of the American Mathematical Society*, vol. xiii., February, 1906.

[2] From the address of Prof. W. F. Magie, president of Section B, Physics.

I would remark about the first question that the theorem is so distinguished by its simplicity, and by its aspect as a sort of unifying principle in nature, that few men can set it fairly before their minds without at least desiring to believe it true. Most of those who have recognised that Maxwell's original demonstration was not flawless are still convinced of the truth of his conclusion, or at least believe his conclusion to be so probable as to make it worth while to try for a more accurate demonstration. Their state of mind is like that of Clausius and of Lord Kelvin, when they perceived that Carnot's theorem respecting the efficiency of a reversible engine could not be proved in the way in which Carnot tried to prove it.

With respect to the second question, it was very soon pointed out that Maxwell had made in his proof an assumption that could not be justified by immediate inspection, and which was itself in need of demonstration or of avoidance. The later demonstrations of Maxwell and Boltzmann have been likewise subjected to criticism, and can be shown to involve assumptions that will not be granted on inspection. The difficulties that arise in these proofs come from the necessity of applying in them the calculus of probabilities, and centre around the question of the legitimacy of the application of that calculus. It is commonly agreed that Maxwell and Boltzmann have assumed a condition of the system of moving particles, as a requisite for the application of the calculus of probabilities, which is contradicted by many systems of which we have certain knowledge, and cannot without proof be admitted as likely to obtain in other systems, about which less is known. In the method employed by Jeans the application of the calculus of probabilities is made in a different manner, and does not necessitate the introduction of the hypothesis of Maxwell and Boltzmann. It seems to me that, in this last form of the theory, the difficulties which have environed the subject have at last been mastered.

In respect to the third question, that concerning the experimental evidence for the truth of the theorem, it is well known that, in general, Boyle's law follows as a consequence of the general principles of the kinetic theory, that Gay-Lussac's law is an immediate consequence of a relation plausibly assumed between temperature and the kinetic energy of the molecule, that the motion of the radiometer and the laws of transpiration and many other properties of gases can be deduced from the general theory, and, in particular, that Avogadro's law follows from the simplest form of the theorem of equipartition. But further proof of this theorem in its general form is still needed. Such proof as we have will be discussed in this address.

Considering the bearing of the relations that have been adduced upon the general question of the equipartition of energy, it seems to me that their general consistency with that principle, especially the way in which the heat capacities of the organic compounds can be portioned out among the atoms by means of simple assumptions about their degrees of freedom, does afford some confirmation of the principle. Mere chance can hardly account for so large a number of successful coincidences.

The Sanitary Value of a Water Analysis.[1]

Though much valuable information can be obtained from the careful study of the nitrogen content of a water, the water analyst does not depend alone upon these factors in forming an opinion as to the source of the organic matter, and turns to other chemical as well as to bacterial data to substantiate or modify the opinion thus formed. From the chemical point of view the most important of these data is the combined chlorine that a water contains. This is due to the fact that though chloride of sodium occurs in rain-water, especially near the sea, and in small amounts is found in all soils, it is a characteristic constituent of sewage, the animal body expelling the same amount of salt as it absorbs.

A careful study of the amount of combined chlorine in normal waters, made by Prof. Thomas M. Drown, showed that in Massachusetts, where salt-bearing strata do not occur, the amount of chlorine in a surface water depended on its distance from the sea, and that for Massachusetts

[1] From the address of Prof. Leonhard P. Kinnicutt, president of Section C, Chemistry.

it was possible to establish normal chlorine, or, as they are commonly called, iso-chlor lines.

The work begun by Prof. Drown has been carried on by other investigators, and to-day the iso-chlor lines for all the New England States and New York and New Jersey have been determined. The result of this work is that the amount of chlorine occurring in the surface waters of the above named States gives most valuable information. Chlorine above the normal of the region shows pollution. It does not indicate whether the pollution is direct or indirect, but does show that sewage, from which the organic matter and the germs of disease may or may not have been removed by filtration through soil, has had access to the water. Chlorine above the normal is, therefore, always a suspicious sign which must be investigated. I know that it is claimed that in many of the western States, owing to geological conditions, very little information can be obtained from the determination of chlorine. I believe, however, more careful and thorough work is necessary to prove that such is the case, and that further investigation may show that though it is impossible to construct iso chlor lines running through the State, the normal chlorine of different localities in a State can often be determined.

Another factor that is often used in the attempt to decide whether or not a water contains an excessive amount of organic matter is the oxygen consumed. The oxygen consumed is not, however, a measure of the organic matter in a water, but only a measure of the amount of mineral reducing salts plus a certain amount of the organic matter, the amount depending on the method of determination used. It gives, in my opinion, very little information as to the character of the organic matter, and is only valuable when different surface waters are to be compared with each other, or when used in filtration experiments.

The same may be said as regards colour, turbidity, and the amount of mineral matter that a surface water contains, that, though of essential importance in deciding on the value of a normal water as a potable water, they give little information as to pollution.

In the early days of bacteriology it was claimed that the final criterion as to pollution of a water would be furnished by aid of that science, and though this hope has not been fulfilled, the information that can be gained by a bacterial analysis is often of the highest importance. It not only aids in the interpretation of the chemical data, but may of itself show, almost without question, that a given water is polluted, for though attempts to isolate special pathogenic germs have generally failed, even in waters known to contain these forms, characteristic sewage forms, like the colon bacillus, can be isolated if they occur in any number in a water. Occurrence of numerous characteristic sewage bacteria can point only to one thing, pollution, and if such forms are found there is no question that the water receives sewage drainage. Bacteriology, however, cannot determine, except very roughly, the amount of pollution or the present condition of the polluting matter, nor does it give but very little, if any, information as to past pollution. If the pollution is recent and of any considerable amount, a careful bacterial examination will show the fact, and probably better and more convincingly than any chemical analysis. If the pollution is more remote, more information can, as a rule, be drawn from chemical than from bacterial data. If the polluting matter has filtered through the soil before entering the water, bacterial work will not indicate the fact.

As a general statement, it may be said that a bacterial analysis, while giving information as regards recent and continuous pollution, gives no information as to the past history of a water, and in this respect differs from a sanitary chemical analysis.

To form a judgment as to the wholesomeness of a water, the data of a sanitary water analysis, the source of the water, whether surface, ground, or artesian, must be known; a survey, even of a surface water, though it may show whether or not the water is polluted, does not give information regarding the amount or condition of the polluting matter; with ground and artesian waters it often gives very little information, and an opinion regarding the character of such waters must, as a rule, depend on the sanitary analysis.

The Generic Concept in the Classification of the Flowering Plants.[1]

The difficulties of classifying plants in a really natural and logical way are somewhat increased by the involuntary and well-nigh necessary admission of a certain historic element into our systems. There is another source of this artificiality, besides the temptation to allow poor genera to stand, on the ground of long usage. The relation of a genus to its name is a matter which exerts no small influence in this regard. The attempt to determine which of several names is to be retained for a given genus constantly forces us to consider the historic basis on which the genus rests, and to attach its name to some species or group of species to which it was first applied, to determine, in other words, what was the type of the genus, and to maintain the genus in such a way that it may always be true to its type. While sympathising to a considerable extent with those botanists who desire to place our nomenclature upon a more secure basis by attaching the names to recognised types, I feel that the methods employed will have to be very cautiously applied, or they will tend greatly to increase the artificial element in our system. The historic type is not a natural thing; it is merely that particular form of plant life which was, often quite by accident, first discovered and, therefore, first received the name which it bears. Later discoveries often show that this first species of a genus is by no means of a typical, or, as one may say, central character. It is often quite peripheral, perhaps even an aberrant or outlying member of the group to which it belongs. However important the historic type may be in nomenclature, it is obvious that it is of no particular significance in classification, and any employment of the type method in the determination of proper names must not on any account be permitted to exercise any influence in classification. The word type itself is decidedly unfortunate as thus applied to what is often very far from being typical. In this as in some other phases of taxonomy it is of the greatest importance to keep it clearly in mind that nomenclature, although very necessary to classification, is a thing wholly apart from the classification itself. It is, furthermore, quite evident that nomenclature should be subservient to classification, and that the clearness and accuracy of classification should never be sacrificed in order to give beauty or symmetry to any system of nomenclature.

The limitation of genera has always in the past rested on individual judgment, and it must continue to do so in the future. Although the genera of the flowering plants have now been scientifically studied for about two centuries, there is at present in America, at least, a degree of diversity in their interpretation which is rather discouraging. It is disheartening because it is impossible to see in it any real progress toward a well rounded and satisfying system, which will win the confidence of the professional botanist, give uniform training to the student, and command the respect of our colleagues in other branches of science. From this, I think that it is perfectly clear that botanical systematists have certain imperative duties in regard to this subject. These duties are, in the first place, great caution in making changes, and, in the second place, a feeling of obligation, when these changes seem necessary, to state the reasons for them so clearly and forcibly that they will appeal to all thoughtful and discriminating workers in the same field. The burden of proof should always rest upon the writer suggesting the change.

What we need in botanical classification is a series of constants, a number of graded categories which can be generally endorsed and properly respected. Standards as definite as those of the physicist are, of course, quite unattainable in dealing with the variable and often intergrading groups of organic creation. But where absolute accuracy and uniformity are impossible, we should the more diligently seek to preserve such standards as exist. As has been pointed out, there are but few families of flowering plants which have not been comprehensively treated by monographers who, so far as their particular group was concerned, have been in a position to see pretty

1 From the address of Prof. B. L. Robinson, president of Section G, Botany.

clearly where it was best to draw generic lines. While it must be admitted that there are many minor differences in the generic concepts exhibited in the scholarly and monumental works to which I here refer, yet they establish a good usage, which on the whole has a considerable measure of uniformity, and goes far to establish the rank of such categories as genus, species, and variety.

Let me urge that, while we remit no effort to secure further light on this subject, there should be a general agreement to treat the accepted and traditional interpretation of large and important genera as sacred and binding until we can furnish definite and convincing evidence that change is needful, and that for the welfare and dignity of our science all should unite in opposing changes of the artificial sort, which consist merely in the shifting of ranks and modification of standards.

Investigations and Commercial Tests in Connection with the Work of an Engineering College.[1]

In any school it is necessary, in securing the best efficiency in instruction, that the professors shall be able to speak with authority on the subjects which they teach. In technical schools those who teach the practical engineering subjects cannot speak with authority unless they have had practical experience. Investigations and commercial tests may serve to give them this practical experience, and the question naturally arises, Is it a good policy for professors to conduct such work in connection with their regular college duties?

Let us consider the various ways in which a professor in an engineering school may acquire the practical experience which is necessary in his work.

First, he may be called to a professorship from the practical field.

Second, after teaching for a time and finding how necessary a practical experience is in his work, he may turn to the practical field, and then return to teaching.

Third, he may undertake practical work in connection with his college duties, and gain his experience in this way.

Each method possesses its own advantages and disadvantages. Starting with the first, it must be admitted that many of our best instructors have entered the teaching line after they have had experience in the practical field. Such a man has an advantage in being able to make use of this experience immediately, when he starts at his teaching work. There is a disadvantage, however, in the fact that should he have secured a mature experience in the practical field, he will necessarily be no longer a young man, and it may be hard for him to teach and properly to adapt himself to the theoretical part of his course.

The advantages of the second system of securing a practical experience, where the professor leaves the teaching field, takes up outside work, and then returns to teaching, are that during his practical career he will be very much alive to the points he should look into, and, furthermore, if he returns to teaching he will possess the advantage of having experience both as a teacher and as a practical engineer.

We will now take up the third method, where a professor obtains his practical experience by conducting outside work in connection with his college duties. The outside work undertaken by a professor should be that of a scientific or strictly engineering type.

The advantage to a college in having its professors do research and outside work is that what reflects to the credit of the professor will reflect to the credit of the college. Furthermore, the college will be looked to as a source from which an unbiased opinion can be obtained, and in maintaining this standard it will be fulfilling a high and useful mission. The results of the investigations may be made the subjects of scientific papers to be read before the various societies, and any reputation that a professor gains in this way will benefit his college.

The day is past when there can be a strict line drawn between the work of the consulting engineer and that of the professor who teaches in the same field. The ideal professor in a given line should be able to take up the work of the consulting engineer in that line, and the ideal consulting engineer should possess enough technical knowledge to fit him for being a professor. There should be no jealousy, but rather a bond of friendship in that the fundamentals which each should master are the same.

[1] From the address of Prof. D. S. Jacobus, president of Section D, Mechanical Science and Engineering.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The results of a census undertaken each year by the *Magazine* show that there are 2722 undergraduates actually in residence this term, as compared with 2021 in Hilary term, 1905. The increase is probably due to the Rhodes scholars and to the fact that a larger proportion of undergraduates now complete three years of residence than was the case a few years back. The three largest colleges are Christ Church, New College, and Balliol, with 211, 210, and 181 members in residence.

A long vacation course in geography will be held in Oxford between August 7 and 25, provided that sufficient names are sent to the Reader in Geography, Old Ashmolean Building, Oxford, by June 1. The course will include lectures and demonstrations in the School of Geography, and surveying and map-drawing in the field.

At a meeting of the Junior Scientific Club, held on Wednesday, February 14, at the museum, papers were read by Prof. Miers on "Spontaneous Crystallisation," and by Mr. C. G. E. Farmer on "The Use of Finely Divided Metals in Organic Chemistry."

CAMBRIDGE.—The regulations for the diploma in mining engineering were passed by the Senate last Thursday. Among the chief of these regulations is that the candidate may take such parts of the natural sciences tripos and of the special examination in mechanism and applied sciences as bear upon the subject of mining engineering, or a candidate may take honours in the mechanical sciences tripos. Details of the examination and the schedules in the art of mining and in metallurgy will be found in the *Cambridge University Reporter* for December 5, 1905.

The Smith's prizes for 1904 have been adjudged as follows, the names being in alphabetical order:—C. F. Russell, Pembroke, for his essay on "The Geometrical Interpretation of Apolar Binary Forms"; F. J. M. Stratton, Gonville and Caius College, for his essay on "A Problem in Tidal Evolution Suggested by the Motion of Saturn's Ninth Satellite."

Mr. J. W. Nicholson, of Trinity College, has been elected to the Isaac Newton studentship in astronomy and physical optics, of the value of 250*l.* for one year, for study and research in astronomy.

Mr. R. H. Rastall, late scholar of Christ's College, Harkness scholar in 1903, has been elected to a junior fellowship at Christ's College. Mr. Rastall has worked chiefly in the Geological Museum at Cambridge, and has written on the Blea Wyke beds of Yorkshire and on "The Buttermere and Ennerdale Granophyre" of Lakeland.

DR. C. H. LEES, lecturer in physics and assistant director of the physical laboratories of the University of Manchester, has been appointed professor of physics at the East London College.

THE King's Speech, read by His Majesty at the opening of Parliament on Monday, promised that, at the earliest possible moment, a Bill would be introduced "for amending the existing law with regard to education in England and Wales."

THE Lancashire County Education Committee has recommended the council to make a grant of 100*l.* a year to the fund for the establishment of a department in economic botany in the University of Liverpool. The cost of the proposed department has in consequence now been completely guaranteed.

THE Senate of the University of St. Andrews has resolved to confer the following honorary degrees, among others, at the graduation ceremonial on April 3:—LL.D., Dr. A. C. L. G. Gunther, F.R.S., in appreciation of his lifelong and distinguished labours in zoology, Prof. J. C. Wilson, Oxford, and Prof. A. H. Young, Manchester.

An open competitive examination for not fewer than twelve situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in April next. The examination will commence on April 23, and forms of application for admission to it are now ready for issue, and may be obtained on request addressed by letter to the secretary, Civil Service Commission, Burlington Gardens, London, W.

At the annual conference of the Labour Representation Committee held on February 16 considerable discussion took place on the following resolution:—"That this conference condemns the educational policy of the Government as laid down in the Act of 1902, and demands the formulation of an educational programme based upon the principle of equal opportunities for all, such programme to aim at securing—(1) that immediate provision be made for giving at least one free meal per day to all school children; (2) that all grades of education shall be free and State maintained; (3) that all education shall be free, and that secondary and technological education be placed within the reach of every child by the granting of bursaries or maintenance scholarships to all children whose usefulness would be enhanced by such extended education; further, that adequate provision be made for children to continue at school until the age of sixteen years, or until such age as the university course begins; (4) that provision be made to continue the education of capable students through the university courses; (5) that the standard of capacity shall be judged by work previously accomplished, and not by competitive examination; (6) that the education in all State-supported schools shall be secular; (7) that all State-supported schools shall be under the control of and their affairs administered by the directly elected representatives of the people; (8) that each educational district shall be required to train the number of pupil teachers demanded by local needs, and for this purpose to establish training colleges, preferably in connection with universities or university colleges; (9) that the cost of the above-mentioned reforms shall be borne by the National Exchequer out of revenue obtained through broadening the basis of taxation, and by the restoration and democratic administration of valuable misappropriated educational charities and endowments." "This conference, therefore, instructs the committee (or such body as may be appointed for the purpose) to draft a Bill embodying the principle of the said resolution, with a view to the Labour group introducing it early into Parliament." A division having been taken, the result was declared as follows:—817,000 votes for the resolution and 76,000 for its rejection. The resolution was therefore carried. In view of the growing importance of the labour interest, it is satisfactory and gratifying to find a large and representative body of labour delegates appreciating the fact that the future welfare of the country is closely bound up with the provision of a rational system of national education.

The publication on February 19 of a correspondence between Mr. A. H. D. Acland, formerly Minister of Education, and Mr. Birrell, President of the Board of Education, is gratifying evidence that at last something is to be done in the direction of providing adequate Exchequer grants for English secondary education. Mr. Birrell, in reply to a series of suggestions made by Mr. Acland, announces that provision is to be made in the Estimates for this year for a considerable increase of the Exchequer grants (1) in aid of secondary schools; (2) to alleviate the burden now placed upon local authorities in respect of the education of teachers; and (3) to assist further the building of training colleges for teachers by the local authorities. How much higher education in this country has suffered from the inadequate education of boys in our secondary schools, which, through want of funds, are too often under- and inefficiently staffed and equipped, has been pointed out in these columns with patient persistence. It is earnestly to be hoped that the findings of the Royal Commission on Secondary Education of ten years ago will now be considered seriously, and a statesmanlike attempt made to secure for the pupils in whose hands our future success as a manufacturing nation lies, a rational and complete secondary education which will enable them to take proper advantage of higher technical instruction. The promise that local education authorities are to be helped—in a degree commensurate with modern needs—in the pressing work of supplying more training college accommodation is heartily to be welcomed. The proportion of fully trained teachers in our elementary schools is at present scandalously low; and this is due primarily to the fact that until quite recently the only training colleges were those built—with the aid of special State grants like that of 1835—by the National and the British and Foreign School Societies, and supported largely by Government grants on each teacher in training. Though in recent years the work of day training departments in connection with university colleges has improved the facilities for the training of teachers, much yet remains to be accomplished if English elementary education is to take advantage of modern educational enlightenment. Local education authorities, with their knowledge of local needs, will be in a position, when helped by the promised Treasury grants, to start the much needed provision of more colleges where teachers may become acquainted with the principles upon which successful teaching must be based. In carrying out this important work, the need of training for secondary school teachers must not be forgotten. Most masters in secondary schools begin their work knowing only what to teach, and nothing of how to teach.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 25.—"On the Effect of High Temperatures on Radium Emanation." By W. **Makower.** Communicated by Prof. Arthur Schuster, F.R.S.

(1) The activity of radium emanation in radio-active equilibrium with its products A, B, and C, is changed by heating above 1000° C.

(2) The effect increases with the temperature up to 1200° C., and possibly beyond this temperature.

(3) The effect increases with the time of heating for about the first hour, but subsequent heating is without effect.

PARIS.

Academy of Sciences, February 12.—M. H. Poincaré in the chair.—Some properties of the α rays emitted by radium and by bodies rendered active by radium: Henri **Becquerel.** Some experiments of Prof. Rutherford recently published have led the author to repeat some of his earlier work on the deviation of the radium rays. In the present paper full details are given of the strength of the magnetic field, and the dimensions and arrangement of the apparatus. As a result, M. Becquerel definitely rejects the interpretation deduced by him from his earlier experiments and the hypothesis of an increase in the radius of curvature along the trajectory, and accepts the explanation of Prof. Rutherford, all the measurements confirming the existence of a reduced velocity for the α rays when traversing a leaf of aluminium. There is no difference in the behaviour of α rays arising from radium salts or from bodies rendered active by the emanation.—The internal pressure of fluids and the equation of Clausius: E. H. **Amagat.**—Some lemmas relating to quasi-waves of shock: P. **Duhem.**—Observation of the eclipse of the moon of February 9, 1906, made at the Observatory of Paris: P. **Salet.** Note on the time of contact, with especial reference to the difference observed between the photographic and visual observations in different eclipses.—Observations of the Brooks comet (1906*a*) made at the Observatory of Algiers with the 31·8 cm. equatorial: MM. **Rambaud** and **Sy.** Observations on the apparent positions of the comet and the positions of the comparison stars were made on January 31 and February 2. On January 31 the comet had the appearance of a round nebulosity with an eccentric nucleus, with a lustre comparable with that of a star of the eleventh magnitude.—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the third quarter of 1905: J. **Guillaume.** Fifty-six days were available for observations during the quarter, the results of which are summarised in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Integral functions: Ed. **Maillet.**—A

hyperelliptic Hessian. Louis **Remy.**—The extinction of a solitary wave propagated along a horizontal elastic tube: A. **Boulanger.**—A comparison of the time of discharge in an X-ray tube and of a spark in series with the tube producing the rays: Bernard **Brunhes.** Remarks on a recent paper by M. André Broca, and directing attention to a paper published by the author in 1900 on the same subject.—The recombination of the ions in saline vapours: G. **Moreau.** The ions of salt vapours, both by their mobilities and by the values of the coefficient α, for temperatures between 170° C. and 0° C., are intermediate between the ions of ordinary gases and the large ions due to the oxidation of phosphorus. Their mass diminishes as the temperature rises, and in a flame, for the negative ion, they become comparable with kathodic particles, and, for the positive ion, with the atom of hydrogen.—Remarks on the combinations of the rare metals of the cerium group and on their sulphates: Camille **Matignon.** A reply to a claim for priority made by M. Otto Brill.—Calcium iodomercurates: A. **Duboin.** These salts are prepared by alternately adding calcium iodide and mercuric iodide to water, finishing with a slight excess of the calcium salt. The solution had a density of 2·89 at 16° C., and three crystalline compounds were isolated from the solution.—The existence of sulphides of phosphorus: H. **Giran.** Various mixtures of phosphorus and sulphur were heated in sealed tubes to 200° C., and the melting points taken after solidification. The results are given graphically. The four maximum points correspond exactly to the proportions of sulphur indicated by the sulphides P_4S_3, P_2S_3, P_2S_5, and PS_6.—The preparation and properties of strontium: MM. **Guntz** and **Rœderer.** Strontium amalgam is heated in a current of hydrogen until the whole of the mercury is expelled, strontium hydride remaining. This hydride, heated in a vacuum at 1000° C., is dissociated, the vapours of strontium being condensed on a cool tube. The metal thus produced contained 99·43 per cent. of strontium, and was utilised in redetermining some thermochemical data.—The action of some esters of some dibasic acids on the halogen-magnesium derivatives of the primary aromatic amines: F. **Bodroux.**—The constitution of the sulphates of chromium: Albert **Colson.**—The existence of bicarbonates in mineral waters, and on the supposed anomalies of their osmotic pressure: L. C. **Maillard** and Lucien **Graux.** For one specimen of mineral water it is shown that the cryoscopic results are not opposed to the idea of the existence of bicarbonates in mineral water.—A new mode of extraction of oil of anise: Ph. **Eberhardt.** The oil can be extracted from the leaves as well as the fruit.—The anti-coagulating power of the blood serum of the lower animals: J. **Sellier.** Serum extracted from some fishes and invertebrates has the power of preventing the coagulation of milk by rennet.—The annelids of the Red Sea: Ch. **Gravier.**—The salivary glands of the snail (*Helix pomata*): M. **Pacaut** and P. **Vigier.**—The mechanism of the pathological modality special to each organ in the course of a general disease: A. **Charrin.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—On the Coefficient of Viscous Traction and its Relation to that of Viscosity: Prof. F. T. Trouton, F.R.S.—Contributions to our Knowledge of the Poison Plants of Western Australia. Part I. Cygnine: E. A. Mann and Dr. W. H. Ince.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Crane Motors and Controllers: C. W. Hill.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 9.—The Internal Architecture of Metals: Prof. John O. Arnold.

PHYSICAL SOCIETY, at 5.—A Note on Talbot's Bands: J. Walker.—Secondary Röntgen Radiation: C. G. Barkla.—Records of the Difference of Potential between Railway Lines, and a Suggested Method for the Observation of Earth-Currents and Magnetic Variations: C. W. S. Crawley and F. B. O. Hawes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Graphical Determination of the Deflection of Beams: C. H. Sumner.

SATURDAY, FEBRUARY 24.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford at 6.30.—The Mosses of Essex: a Contribution to the Flora of the County: F. J. Chittenden.—Mysterious Subsidence at Mucking, Essex. Miscellaneous Denehole Notes, 1906: T. V. Holmes.

MONDAY, FEBRUARY 26.

SOCIETY OF ARTS, at 8.—Modern Warships: Sir William White, K.C.B. F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels on the Boundaries of Bolivia and Peru: Baron Erland Nordenskjöld.

INSTITUTE OF ACTUARIES, at 5.—On a Form of Spurious Selection which may arise when Mortality Tables are Amalgamated: W. Palin Elderton.

TUESDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 5.—Food and Nutrition: Prof. W. Stirling.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anthropological Notes from Lake Tanganyika: W. A. Cunnington.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Adjourned Discussion*: A Plea for Better Country Roads: G. R. Jebb.—Country Roads for Modern Traffic: J. E. Blackwall.

WEDNESDAY, FEBRUARY 28.

SOCIETY OF ARTS, at 8.—London Traffic: Captain G. S. C. Swinton

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experimental Inquiry into the Factors which Determine the Growth and Activity of the Mammary Glands: Miss J. E. Lane-Claypon and Prof. E. H. Starling, F.R.S.—The Specificity of the Opsonic Substances in the Blood Serum: Dr. W. Bulloch and G. T. Western.—The Internal Anatomy of Stomoxys: Lieut. F. Tulloch.

CHEMICAL SOCIETY, at 8.30.—Studies of Dynamic Isomerism. Part IV. Stereoisomeric Halogen Derivatives of Camphor: T. M. Lowry.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: F. Darwin, F.R.S.

LINNEAN SOCIETY, at 8.—On a New Type of Stem from the Coal-measures: Dr. D. H. Scott, F.R.S.—Notes on Some Species of Nereis in the District of the Thames Estuary: Dr. H. C. Sorby, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Coast Lines Protected by Chain Cable Groynes: R. G. Allanson-Winn.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 9.—Hippocrates and the Newly Discovered Health Temple at Cos: Dr. R. Caton.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

CONTENTS.

PAGE

THURSDAY, MARCH 1, 1906.

MATHEMATICAL ASTRONOMY.

The Collected Mathematical Works of George William Hill. Vol. i. Pp. xviii+363. (Washington: The Carnegie Institution, 1905.)

IT is a rare mind that can handle the cumbrous developments of practical astronomy and leave uppermost with a reader the impression of variety, ease, and polish; and curiosity will be felt as to the circumstances which have developed Hill's remarkable powers. From an interesting introduction to the present volume by M. Poincaré we learn that he spent three years at Rutgers College, New Jersey, under a certain Dr. Strong. Dr. Strong "était un homme de tradition, un laudator temporis acti; pour lui Euler était le Dieu des Mathématiques, et après lui la décadence avait commencé; il est vrai que c'est là un dieu que l'on peut adorer avec profit," and if it led Hill to the study of originals, we may overlook the depreciation of the moderns. From New Jersey he went to Cambridge to continue his studies at Harvard; very soon here, by a paper contributed for a prize to a mathematical miscellany, he attracted the notice of Runkle, the editor, who was Newcomb's predecessor at the office of the *American Ephemeris*. Hill became attached to the *Ephemeris* as computer, and remained in discharge of these duties for thirty-two years. At first he worked at his own home, as was then the custom; but under Newcomb's management, and in order to complete his theory and tables of Jupiter and Saturn he lived for some years at Washington, incessantly absorbed in his task. "The only defect of his make-up of which I have reason to complain," Newcomb has written, "is the lack of the teaching faculty." In 1892 he withdrew to the little farm where his boyhood was passed, and where he still lives, asking nothing but the liberty to continue his labours.

The present volume carries us up to 1881, and includes most, but by no means all, of his best known papers. The essay which attracted Runkle's notice is No. 3, "On the Conformation of the Earth," and was written at the age of twenty-three. It is perhaps not of any permanent importance, yet it is marked by the clearness and the firm hand of his later writings and the same salutary determination that theory should give an account of itself arithmetically. It is natural to compare it with Stokes's memoir "On the Variation of Gravity," written some twelve years before, when he also was a young man, and the comparison shows strikingly how Stokes is the physicist and Hill the analyst.

The two great memoirs by which Hill is best known are No. 29, "On the Part of the Motion of the Lunar Perigee which is a Function of the Mean Motions of the Sun and Moon," and No. 32, "Researches in the Lunar Theory." These writings have been greatly praised, but it seems impossible to praise them too highly, whether for their difficulties or the way these are overcome, or the greatness of the advance which their solution implies. The latter paper was the first which threw any real light upon the general problem of three bodies, and it is well worth notice how large a part arithmetic plays in its success. The analysis is pregnant in the extreme, but it is the actual calculation of a whole sequence of periodic orbits which a moon might occupy that gives it shape and name.

If this memoir may be said to be the first significant word on the problem of three bodies, the former one, on the motion of the lunar perigee, seems to be almost the last word on a question that had outrun calculation from Newton's day to Delaunay's. It is doubtful whether the more determined effort to calculate this quantity was made by Newton or by Delaunay, but though naturally the degrees of approximation they attained were very different, they had this in common, that they proved the inadequacy of the methods employed. Hill first, with the smoothness of a conjurer, gives form to the intractable equations, and then shows how the solution is contained in a certain transcendental equation, an infinite determinant. It affords striking evidence of Hill's power to contrast his treatment of this determinant with that of Adams, who followed a similar route, *sed longo intervallo*, as he said himself. The complexity arising from an infinite sequence of equations might seem to preclude any general conclusions from being drawn, but Hill uses this very feature in the most beautiful manner to derive the eliminant in a transcendental form in the shape $\cos \pi c =$ a known quantity, and from this equation determines c, the required ratio. The secret of the success is now apparent. c is nearly equal to unity; hence it is very much easier to approximate to $\cos \pi c$, where we are in the neighbourhood of a stationary value, than to c directly; and though the difficulty recurs when we seek to find the arc πc from a cosine in the neighbourhood of its minimum, it is then an insignificant one, for we are past the true complexities of the problem.[1]

The remaining papers are naturally not of equal moment with these, but we may be grateful to the Carnegie Institution for making them accessible in the present collection. Several of them arose in connection with Hill's duties as computer to the *Ephemeris*, but even on such hackneyed subjects as eclipse computing and reduction of star places he has something good to say. He is a true artist; *nullum quod tetigit non ornavit*. Of considerable general interest are No. 18, "Remarks on the Stability of Planetary Systems," and No. 14, "A Method of Computing Absolute Perturbations," which contains a rescension of Hansen. Even the smaller papers, like No. 22, "On the Solution of the Cubic and Biquadratic Equations," are usually marked by some analytical felicity that makes one wish that Hill had been able to bring his great powers to bear upon a material not so invariably intractable and overloaded with tradition, and limited in its problems, as practical astronomy. But if we feel that his hand

[1] The point of this approximation is put somewhat incorrectly by M. Poincaré in his introduction.

is subdued to what it works in, we feel, too, that that is an essential ingredient of his success, and that with less complete absorption his work might have been less brilliant as well as less convincing.

R. A. S.

ULTRAMICROSCOPIC STUDIES OF THE COLLOIDS.

Zur Erkenntniss der Kolloide. Ueber irreversible Hydrosole und Ultramikroskopie. By Richard Zsigmondy. Pp. vi+185. (Jena: Gustav Fischer, 1905.) Price 4 marks.

THIS work forms a valuable addition to the literature of the colloids, giving as it does an authoritative account of the results obtained through the application of the method of ultramicroscopy to the study of solutions of colloids.

A brief account is first given of the nature and properties of colloid solutions or hydrosols. At the outset the author refers to the difficulty of giving a satisfactory definition of the term "solution." He adopts homogeneity as the most universal characteristic of solutions. The definition of homogeneity will naturally vary according to the delicacy of the methods employed to test it. By means of the method of ultramicroscopy devised by Zsigmondy and Siedentopf, the majority of colloid and even some crystalloid solutions can be shown to be optically heterogeneous. Every increase in the accuracy of the methods of examination would lead to a further limitation of the term "solution." In order to include the colloids Zsigmondy defines solutions as uniform distributions of solids in fluids, which are transparent to ordinary light, and not separable into their constituents by the action of gravity or by filtration.

In order to gain a clearer idea of the nature of colloid solutions, it is necessary to find criteria for distinguishing such solutions from those of crystalloids on the one hand and from suspensions on the other. Zsigmondy only refers very briefly to the distinguishing characteristics of the former, as this subject has been previously treated by Bredig in his monograph on "Inorganic Ferments." He deals more fully with the properties of colloid solutions which distinguish them from suspensions. In this connection he mentions the following as the chief features distinguishing colloid solutions from suspensions:—

(1) The particles in colloid solutions are much smaller than in suspensions. In colloid solutions the average diameter of the particles varies from 5 to 20 $\mu\mu$. This difference is, however, one only of degree.

(2) Many colloids are capable of undergoing irreversible changes. Separation of a metal from its colloid solution may be readily brought about by the withdrawal of water or the addition of electrolytes. In this process the metal has undergone an irreversible alteration or coagulation. For the reformation of the colloid solution, chemical or electrical means must be employed. In the case of suspensions, on the other hand, sedimentation rapidly takes place under the influence of gravity, and its rate is little influenced by the withdrawal of water or by the addition of electrolytes. The suspension may be reformed by purely mechanical means.

(3) Alterations in the total energy of the system are frequently associated with the process of coagulation. These have been measured in several cases by means of the calorimeter.

(4) Colloids in solutions are capable of undergoing reactions with one another, which closely simulate purely chemical reactions.

The next section of the book deals with the classification of colloid solutions or hydrosols. The classifications of the hydrosols have been based on two principles, namely, the size of the particles and the reversibility or irreversibility of the hydrosol (Hardy). On plate i. the author gives a graphic representation of a classification of colloids founded on these principles. The reversible colloids differ from the irreversible in not being readily coagulated by the addition of electrolytes. It is noteworthy that irreversible colloids may be partially protected from the coagulating action of electrolytes by the addition of a reversible colloid to their solutions. Great quantitative differences are found to exist in the extent of protection given by different reversible organic colloids to irreversible gold hydrosols.

A historical account of the preparation and properties of irreversible colloid solutions occupies the next section of the book.

The author next gives an interesting account of the development of the method of ultramicroscopy by Siedentopf and himself. A full description is also given of the necessary apparatus and of the method of using it.

The succeeding sections give details of the results of his own researches on gold hydrosols. By means of the ultramicroscope he was enabled to determine approximately the average size of the gold particles, their colour, and the rapidity of their movements both translatory and oscillatory. The limit of size determinable by the ultramicroscope appears to be about 6 $\mu\mu$ in the case of gold hydrosols. Still smaller particles (amicrones) are also present in gold hydrosols. Their presence may be proved by the coagulation of the hydrosols on the addition of electrolytes.

An excellent summary is also given of the results obtained by other observers through examination of various colloid solutions by means of the ultramicroscope.

Brief reference only is made to some points of great theoretical interest, namely, the causes of the stability of colloid solutions, and the mechanism of their formation.

The book concludes with a short summary of what is known with regard to the products of coagulation of colloid solutions.

The work as a whole is to be regarded as a valuable monograph indispensable for those interested in the ultramicroscope and its applications.

J. A. MILROY.

SCIENCE IN ARCHÆOLOGY.

Manuel de Recherches préhistoriques. Issued by the Société préhistorique de France. Pp. 332; with 205 figures and 4 plates. (Paris: Schleicher Frères, éditeurs, 1906.) Price 8 francs.

Last year an eminent English Egyptologist published a handbook for excavators, with especial reference to Egypt, and remarked in his preface that "a complete archæological training would require a full knowledge of history and art, a fair use of languages, and a working familiarity with many sciences." The present work embraces a large number of subjects that should be familiar to the practical archæologist, especially if engaged in field-work on French soil.

The manual is issued by the Prehistoric Society of France, and has been written by several of its leading members. Taken in conjunction with the first congress of the society, held in the autumn at Périgueux, it indicates a widespread interest in the remote past as represented by flint implements, cave deposits, dolmens, and Gaulish burials. Of recent years, more and more emphasis has been laid on the need for systematic excavation as opposed to haphazard relic-hunting by amateurs; and this publication is intended, not only to assist the explorer in his search for records of the past, but also to render them accessible and self-explanatory when found. Private interest and personal feeling always stand in the way of corporate action in such investigations, but much would be gained if the advice contained in this manual were followed by the depredator, if only for his own ends. To put it on the lowest ground, relics accurately labelled and located gain enormously, not only in scientific, but also in market value; and if archæology is to justify its claim to be regarded as a science, scientific exploration must be the rule, and not the rare exception.

The chapters are all much compressed, and none can be singled out as more important than another. There are instructions for all the ordinary branches of exploration in a most compact form; but in spite of the French tradition, we venture to think that the volume would have been even more practical if published in a light but stout binding. A handbook in a paper wrapper is hardly fit for use in the field. Attention may be directed to the method of hardening and preserving skeletons and other bones by means of silicate of potash, and to the practical advantages of the process advocated for preserving iron. This metal is the scourge of museum curators, and neither the soda nor paraffin treatment has proved altogether successful. The simpler, and apparently the more satisfactory, method is to allow the metal to dry for several hours after brushing in water, and then to heat it to a dull red; if allowed to cool slowly, the object should then be rust-proof, and the surface clean and firm.

One of the most useful features of the manual is the table for computing the height of a subject from various bones of the skeleton; this method would no doubt greatly reduce the number of 7-feet skeletons found even in this country. Another point on which emphasis is laid is the desirability of photographing dolmens, menhirs, and other antiquities of the kind precisely from the four cardinal points; picturesque views are dear to the ordinary photographer, but are of little value for purposes of comparison. On this point a caution should have been given as to the difference between the true and magnetic north, as accurate compass bearings of megalithic monuments may often prove of considerable importance.

The student of prehistoric archæology in France and elsewhere will be glad to find the various classifications of the Stone age brought together, even if no attempt is made to coordinate them. The most important are those of Mortillet, Piette, Salmon, Boule, and Rutot, and in the last mentioned occurs (as occasionally elsewhere) the irritating term "Forest Cromer bed." Among the few cases where no scale is indicated for the illustrations is that of the Pressigny nucleus (Fig. 74); the extraordinary size of these flints ought surely to have been stated. Finally, it is somewhat of a shock to the orthodox to find the following item in the glossary at the end:—"*Bulbe de percussion.*—Mot impropre (voir *Conchoïde*)."

OUR BOOK SHELF.

Smoke Abatement: a Manual for the Use of Manufacturers, Inspectors, Medical Officers of Health, Engineers, and Others. By William Nicholson. Pp. xiii+256. (London: Charles Griffin and Co., Ltd.) Price 6s. net.

The author of this handbook is chief inspector to the Sheffield Corporation, and seems to have an extensive acquaintance with the various enactments that have been passed in this and other countries with a view to ameliorate one of the greatest nuisances of modern times, and devotes more than a third of the 250 pages the book contains to their recital. This is undoubtedly useful to those desiring to make themselves acquainted with the legal aspects of the case, but scarcely justifies the subtitle of a "practical handbook," as the author's idea of the nature of smoke is of a most delightfully rudimentary character, and his power, therefore, of prescribing remedies necessarily limited. On searching the book for a clear definition of smoke and a description of the constituents that go to build it up, we find on p. 12 the following:—"Nature of the Nuisance—Smoke consists of minute particles of carbon together with a sticky tarry matter which settles and sticks to everything it comes in contact with. It is dirt. Lord Palmerston's definition of dirt from a health point of view is 'Matter in the wrong place,' and carbon or coal in the atmosphere is matter in the wrong place."

One of the chief remedies suggested by Mr. Nicholson is that the Sanitary Institute should now deal with the question, and arrange for courses of lectures on the subjects of "Smoke and the Injury therefrom," "The Causes of Smoke," and "The Practical Prevention of Smoke," after which examinations should be held, and "certificates of competency given to all who satisfy the examiners." The result of this is foreshadowed by the author as follows:—

"If such facilities were offered, hundreds of engineers and others would avail themselves of them, and would not rest satisfied until they had procured a smoke inspector's certificate, which would become as popular and as valuable as the sanitary inspector's

certificate. Having obtained the certificate and possessing the theoretical as well as the practical knowledge, they would quickly be on the look-out for official appointments, and if there was an unwillingness on the part of the Local Authorities to appoint them, the necessary pressure to compel them to do so would be forthcoming."

If Mr. Nicholson could induce the Sanitary Institute to add a lecture on "The Nature of Smoke" to the course he prescribes, and was to attend it, he would find the information of distinct advantage in dealing with "smoke abatement."

The Preservation of Antiquities, a Handbook for Curators. Translated from the German of Dr. Friedrich Rathgen by Dr. G. A. Auden and Dr. H. A. Auden. Pp. xiv+176; with 48 figures in the text. (Cambridge: University Press, 1905.) Price 4*s.* 6*d.* net.

DR. RATHGEN states in his preface to the German edition of this little book that it is intended to stimulate curators and others interested in the preservation of antiquities to make public their experiences in this branch of archæology.

The first part deals with the changes brought about by the long-continued action of soil, moisture, and air on metals, glass, organic substances, limestone and clay; the materials of which "antiquities" are most usually composed. This is a subject about which very little is known, one of the commonest cases, the "rusting of iron," being still a subject for argument and speculation among chemists. The author, therefore, is only able, as a rule, to state the effects produced by these natural agents, and in comparatively few cases can suggestions be made as to the modes by which these effects are brought about.

In the second part, methods of cleansing recently disinterred antiquities of various kinds and of preserving them are given, and here the author is able to quote largely and usefully from his own wide experience of this work.

The translators have added to the English edition some notes of recent work and additional illustrations which are useful in elucidating various points in the text. The book should be useful not only to curators for reference, but should prove suggestive to all interested in the preservation of natural or artificial structures exposed to the action of air, soil, or moisture.

Organography of Plants. By Dr. K. Goebel. Authorised English edition by Prof. I. Bayley Balfour. Part i., pp. xvi+270. 10*s.* net. Part ii., pp. xiv+708. 21*s.* net. (Oxford: The Clarendon Press.)

THE German edition of the "Organography" has already been reviewed in NATURE (vols. lviii., p. 74, lxiii., p. 149, lxvi., p. 51), and it is unnecessary, therefore, to insist again on the importance of Prof. Goebel's book, both to botanists and to others who are interested in the development of plant life.

The Clarendon Press is to be congratulated on having secured Prof. Bayley Balfour to undertake the responsibility of preparing the English edition, and his name on the title-page carries with it the assurance that the work has been well done. Moreover, his great knowledge of plants has enabled him to give that indefinable cast of originality and interest to the translation that one so often misses in presentations of this kind.

The text is well broken up, by means of headlines and by the use of different founts of type, thus rendering the book more easy to use. The printing, and also the figures, are excellent, and there is a good index, both of illustrations and of subject-matter.

Both the Clarendon Press and the editor have laid English-speaking botanists under obligation by the excellent production in our own language of this important work. J. B. F.

Catalogue of the Madreporarian Corals in the British Museum (Natural History). Vol. v., The Family Poritidæ, ii., The Genus Porites, Part i., Porites of the Indo-Pacific Region. By Henry M. Bernard. Pp. vi+303+xxxv plates. (London: The Trustees of the British Museum, 1905.)

IN the preparation of this important catalogue Mr. Bernard was confronted with the difficulty, experienced by nearly all naturalists who have attempted to arrange corals in specific groups, that the characters afforded by the skeletal structures only are so variable that there is no possibility of accurately defining the limits of "species." This is a difficulty which is wont to grow rather than dwindle as our knowledge of specimens of a genus increases, and Porites being a common and widely distributed coral, represented in the museum by very many specimens from numerous localities, the difficulty presented itself in a particularly exaggerated form.

No one will deny that the binomial system when applied to such a genus is unsatisfactory, and it will probably remain so unless further investigation of the anatomy of the living polyps reveals some characters of better value for purposes of classification. But the system adopted by Mr. Bernard, of abandoning the old specific names and giving the specimens a geographical label and a number, does not appear to offer a more satisfactory solution of the problem, and will not, probably, be generally approved. Unsatisfactory as they may be, many of these specific names are of some value, and all of them of historical interest. To sweep them all away at a stroke is a drastic measure which cannot be recommended, either on the ground of science or expediency.

But even if Mr. Bernard's system is disapproved, naturalists will undoubtedly agree in their tribute of thanks for the skill and patience he has displayed in building up this monumental work on the Indo-Polynesian specimens of the genus. The detailed description of the specimens in the museum will be of value to those who may, in the future, be tempted to grapple with the species question in the genus; but a real and important contribution to knowledge is to be found in the concise statements concerning the morphology of the skeleton and the affinities of the genus. The catalogue is adequately illustrated.

Microscopes and Accessories: How to Make and Use Them. Edited by Paul N. Hasluck. Pp. 160. (London: Cassell and Co., Ltd., 1905.) Price 1*s.* net.

WE are very doubtful whether the first portion of this book, dealing with the practical construction of a microscope by the amateur, will serve any useful purpose. Such an instrument, however well constructed, must almost inevitably fall far short of the perfection attained by the instrument makers, even if the amateur be a first-class mechanic, and efficient instruments may nowadays be picked up second-hand at ridiculously low prices. In the description of the tube, all that is said with regard to the attachment of the objective is that at the bottom (of the tube) a disc of brass is sweated on, the hole in its centre being $\frac{7}{8}$ in. diameter, and chased with a fine thread; not a word about the standard screw now adopted by all makers. The latter portion of the book, dealing with the preparation and mounting of objects, is concise and to the point, but presents nothing novel in its treatment of the subject. R. T. HEWLETT.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Cooperation between Scientific Libraries.

THE note in NATURE (February 15, p. 372) on Dr. T. Muir's paper in the Proceedings of the Royal Society of Edinburgh directs attention to a difficulty which, as you rightly say, affects many others than the mathematicians of Scotland. You adduce, for example, Wales; but may I, without giving offence to the Principality, venture to suggest that the metropolis itself has still better claims to dishonourable mention?

In the two sciences which chiefly appeal to me, geology and zoology, the difficulty mentioned by Dr. Muir has long presented itself forcibly, and there is a lengthy list of books that I have been trying to see in vain, some of them for more than five years. They are, so far as I can ascertain, in none of the many libraries of this city. Naturally, the remedy suggested by Dr. Muir long ago presented itself to me, and I have lost no opportunity of urging it in conversation and in print. In view of your own recognition of the importance of the subject, I venture to ask you to reprint for a wider public the following paragraph from a paper contributed to the *Museums Journal* for April, 1902. After alluding to the cooperation between American libraries in the matter of cataloguing, and to the specialisation among the libraries of Chicago, I wrote:—

"The extraordinary difficulty that a student has, even in London, in seeing the literature of his subject—in fact, the impossibility, unless he is prepared to spend large sums of money on his private library—must have made many a one long for the day when the learned societies and other library authorities of London shall take this question of cooperation in hand. To what end is all this fuss about an international catalogue of scientific literature, with its elaborate mechanism and enormous expense, if, when the list of books is in his hands, it be still impossible for the student to refer to them? The amount of money annually spent by Government, through the libraries of the British Museum, the Education Department, the Patent Office, and the like, when joined with that spent by the great societies, such as the Royal, the Zoological, the Linnean, the Geographical, the Geological, with the College of Surgeons and other public bodies of like character, is surely enough, if properly administered, to buy the world's output of books each year; and far more than enough, if we remember that all publications of the United Kingdom go to the British Museum as a matter of course, and that the donation lists of many of these libraries are nearly as big as their purchase lists. If only the money could be pooled, and the purchases distributed according to some pre-arranged scheme among the various libraries; and if a joint catalogue were prepared, and kept up from month to month, showing not only the titles of books, periodicals, and papers, but the libraries in which they were to be found, then weary searching and fruitless wandering would no longer be the lot of the conscientious student. Even as things are, without so radical a reform as a redistribution of income, I feel sure that a conference of librarians, bent rather on furthering the interests of the reader than the pride of their own institutions, and armed with the necessary powers for cooperation, would soon lift London libraries out of the hopeless muddle that we now have to struggle with."

I hope that now this subject has been taken up in your influential pages it will not be allowed to drop until those concerned have at least attempted the remedy.

F. A. BATHER.

The Blondlot *n*-Rays

IT would be interesting to know whether anyone has obtained success in repeating the latest experiment designed to show the objective reality of the *n*-rays, viz. that described by M. C. Gutton in *Comptes rendus* for January 15.

The writer has repeated M. Gutton's experiment with much care, but has met with no more success in obtaining any positive result than he has in repeating a large number of M. Blondlot's own experiments, most of which he has essayed, in all cases with absolutely negative results, provided proper precautions were taken to avoid effects due to temperature and other extraneous causes of disturbance.

According to M. Gutton's experiment, the effect of the *n*-rays that proceed from a Nernst electric lamp upon a spark in a primary circuit is to diminish the brilliancy of another spark electrically induced in a secondary circuit by the primary discharge. Here one would suppose that the degree of brilliancy of the secondary spark can only be a matter of the amount of the electrical energy in the secondary circuit, but the writer finds that a very sensitive Duddell thermo-galvanometer, which would indicate a very small percentage of variation in the amount of this energy, shows no variation whatever.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., February 20.

A 300-Year Climatic and Solar Cycle.

IN June, 1902, I made a few remarks on an apparent coincidence between sun-spot periods and longer periods of rainfall and famine in north China. Not being, in any sense, a meteorologist, I did not publish my conclusions except locally. In connection with a notice in the "Astronomical Column" of NATURE, November 9 last (vol. lxxiii. p. 38), they are of sufficient general importance to recall them. The notice in NATURE is headed "A 300-year Cycle in Solar Phenomena," and refers to a discussion in the *Astrophysical Journal* wherein Mr. H. W. Clough, of the Washington Weather Bureau, arrives at the conclusion that a 300-year cycle exists in solar and the allied terrestrial phenomena, and finds likewise an intermediate 36-year cycle, and supports both by a reference to various phenomena, such as auroræ, periods of grape harvest, &c.

In 1877 Mr. A. Hosie, H.M. Consul at Chengtu, published a paper in the Journal of the China Branch of the Royal Asiatic Society on droughts in China (new series, xii., 51), extracted from Chinese records. As the records included all China, south as well as north, the tables did not at first sight exhibit any apparent periodicity. Some years after, on making a careful division into north and south, I was struck with a remarkable period of about 300 years, which seemed to me marked clearly in north China as an especial era of drought and famine. As, however, there seemed no reason for founding a new period, for the intercalation of which there was as yet no accumulated evidence, I proceeded no further with the subject. Mr. Hosie's paper went from the year 620 to 1643, covering a period of 1023 years, and attached to it was another notice of sun-spots observed in China, also going back for some 1300 years. The latter table, on account of the want of any observation instruments, is, of course, very fragmentary, but at the time I deduced from it without reference to European observations, which I had not by me, a probable period of 99 maxima in the 1920 years covered, which seemingly gave a mean of 11·085 years, and which, produced to modern times, fell in sufficiently satisfactorily with the European records of the last century. Sir Norman Lockyer in 1901 had also published observations bearing on a climatic curve of about six sun-spot periods, and commenting on all these I made the following remarks, which are entirely confirmative of Mr. Clough's findings, although deduced from such entirely different authorities.

"I now come to the long period or era which Mr. Hosie's records seem to require. The first of these calling for notice seems to cover the three sun-spot periods 664–697, though this is not so well marked as the others. The second covers the similar period from the maximum in 963 to that in 996, when besides two years of drought in northern China, 961 and 962, we find no less than twenty-three years out of the thirty-three characterised by excessive droughts in one or more of the northern provinces. The third covers the periods 1262–1295, when, in addition to the antecedent year 1260, there are noted twenty-one years of drought in the same provinces. The fourth is included between the spot maxima of 1561 and 1594, and though not so marked as the second and third, yet ten years of

drought are recorded, besides the preliminary drought years of 1557–1558. The fifth will, then, cover the equally well marked cycle of drought, which, beginning in or about the year 1860, has continued with scarcely an exception up to the present."

This was written in 1902, and it is noticeable that, as required by the cycle, the intervening years have proved of normal rainfall in northern China. Proceeding, I stated:—

"We have thus four well marked eras of 299·25 years, the beginnings of which in each case were marked by perfectly similar climatal phenomena, each being characterised as a period of drought in some special locality. It has always seemed to me that meteorologists have been in the habit of excessive generalisation, and that the true way to arrive at the secular variations of climate is to compare all observations made within a limited locality, where the conditions are more or less specialised. The mean rainfall of China, as I remarked at the beginning, would not have afforded the necessary data for such a comparison as I have attempted, the reason being that droughts in north and south China are in effect complementary, and never occur contemporaneously: and herein lies the key to the phenomena.

"According to the accepted theory of the 'monsoon,' it is produced by the excessive heating of the continent of Asia between the degrees of 35 and 45 N.L. which causes the rarefied air to flow off and leaves a partial vacuum to be filled in by moist warm air rushing across the equator. If from any cause the heat radiated from the sun be greater one year than another, the regions where the monsoons are elaborated are raised to a higher temperature, and the force of the monsoon increased, and the warm air carrying an extra supply of moisture is carried further north and spread over a wider area; hence the north of China, the usual limit of the monsoon, is superabundantly watered.

"If, however, the heating of the surface be insufficient to set up the normal circulation, the moisture from the tropics is dumped down in or about the latitude of the Yangtse basin, and mid-China receives a superabundant supply of rain, while the entire north is parched, and famine in one or more province is the result. Hence a wet summer in Shanghai is rarely or never accompanied by a sufficient rainfall in the north."

Similar conditions to a large extent prevail in India, and hence it has happened that the latter third of the last century was a period of drought and famine, which severely taxed the resources of the country. I wound up the note with the following remarks:—"It is not for me to suggest an explanation. But the 299¼ year will probably be found to depend on some hitherto unsuspected cosmical cause."

I do not pretend in this to take any credit to myself for any discovery. My part was confined to drawing up a column of centuries divided into three lines; in one was marked the year, in the second the dates when sun-spots had been observed, and in the third the years when droughts had been recorded in the northern provinces; in each of the latter a dark line was drawn across the column. The result was remarkable at the first glance, the dark lines congregating themselves thickly at the ends of the seventh, tenth, thirteenth, and sixteenth centuries, the rest being almost a blank. Personal experience showed me how the nineteenth century had followed the same rule. Mr. Clough's observations may therefore be looked upon as fully borne out by Chinese records; and it only remains to ascertain the cause of the phenomenon, which has certainly had a very considerable effect on the history of Asia.

I may point out the curious coincidence that the climatic cycle of about thirty-four years seems to agree with three sun-spot cycles, while the greater period of 299¼ would seem to correspond with twenty-seven.

Shanghai, January 8. THOS. W. KINGSMILL.

The Origin of Bronze.

IN connection with Prof. W. Gowland's remarks on the origin of bronze in his presidential address to the Anthropological Institute, abstracted in your issue of February 15 (p. 381), it may be of interest to direct attention to the fact that Plutarch, in his "De defectu oraculorum," refers to worked-out copper deposits in the island of Eubœa, from which were formerly manufactured swords which were "cold-forged" (ψυχρήλατος), and in this connection he quotes Æschylus, who mentions a "self-sharpened (αὐτόθηκτος) Eubœan sword," self-sharpened meaning, I presume, sharpened without fire. I believe that bronze containing only a small proportion of tin is malleable in the cold, but do not know if this would be the case with that referred to by Prof. Gowland as containing antimony. It would be interesting to know if tin is associated with copper in Eubœa. Swords of pure copper would hardly be of much use.

JOHN W. EVANS.

Imperial Institute, February 23.

Result of War affected by Soldier's Stature.

MR. TWIGG at p. 340 of your issue of February 8 points out that the Japanese had an unquestionable advantage in the recent war, as being smaller than the Russians—they were smaller targets for fire-arms. This is quite correct, but the advantage is inversely as the cubes of their heights, and not as the squares only, which would only apply to plank dummies. Bullets come from all sides, and not from the front only, so that the thickness of the men's bodies must be taken into account as well as their height and breadth. The average targets offered by each to the enemy are (taking Mr. Twigg's figures) as the cubes of 1585 and 1642, or as 106 to 118, an advantage in favour of the Japanese of about 12 per cent., or nearly double that calculated by Mr. Twigg.

W. E. WARRAND.

Westhorpe Hall, Notts, February 24.

TWO BOOKS ON BIRDS.[1]

TO watch the ways and habits of birds is a taste which is growing rapidly. Some watchers of birds, indeed, are not content to stop at observing their habits; they want to know how the birds acquired those habits and of what use they are to them. They speculate upon what a certain habit, if persisted in, may ultimately lead to. They wish to know, among other things, how a bird came by its colours, and what purpose in the bird's economy is served by, for instance, the red inside to its mouth, seen only when it gapes. And when careful, minute, and scrupulously accurate observers write down on the spot what they see, or think they see, natural history will always be the richer for their labours; and the theories and speculations which these inquisitors weave from what they have seen and heard cannot fail to prove interesting and suggestive reading.

Mr. Selous, at once the pioneer and the great exponent of this "close observation," who in a former work on bird watching touched upon the birds of the Shetlands, returned to his loved islands two years later, and now gives us a whole volume devoted to their birds and seals. In some three dozen short chapters he discourses, with digressions, delightfully upon his experiences. With the exception of a few "peckings," and minor interpolations—mostly having to do with the working out of ideas jotted down in the rough—the chapters contain his journal, written from day to day amidst the birds with whom he lived without another companion on one or other of these remote islands, "hated by thousands" of birds, and feeling himself the most unpopular person on the island. Nothing more need be said to recommend the book to the notice of those who follow birds in the field. For his digressions, leading him sometimes wide of the subject of birds, the author does not apologise.

[1] "The Bird Watcher in the Shetlands. With some Notes on Seals—and Digressions." By Edmund Selous. Pp. xii+338; with 10 illustrations by J. Smit. (London: J. M. Dent and Co., 1905.) Price 10s 6d. net.

"Nature-Tones and Undertones." Being Sketches of Life in the Open. Illustrated by Photographs from Nature. By J. Maclair Boraston. Pp. 223. (London and Manchester: Sherratt and Hughes, 1905) Price 6s. net.

He rather hopes that this batch of them will make it apparent that they are a part of his method, or, rather, a part of himself; and since they occupy so much space in the book it seems only right that they should appear on his title-page. Possibly the reader is not meant to take them all too seriously, for Mr. Selous warns us that he has not suppressed his errors even when he happened to know them, because, among other reasons, "if one has got in some idea or reflection that pleases one, or a piece of descriptive writing that does not seem amiss, how tiresome to have to scratch it out, merely because it is founded on a wrong apprehension!—the spire to come tumbling just for the want of a base!"

The author rather seems to deprecate being included in the ranks of the ornithologists, his ambition being to make a naturalist who shall use neither a gun nor a cabinet. That is all very well; but to decline to avail oneself of the work done by others is sometimes to miss the clue which would explain some puzzle. If he had handled cabinet specimens, or if he did not "hate the British bird book" so heartily, he might have known why the white lines on the diver's neck shone in such a peculiar way in the sunlight (p. 60), and perhaps would have experienced increased enjoyment in consequence. A theory anent the old puzzle of the puffin and the bunch of fish it brings home in its ornate beak, and some instructive observations on young fulmars, are only a crumb or two out of the good things which we mark in reading many charming pages. One of the illustrations shows birds following the ways of "Nature, red in tooth and claw"; and this (together with that of a herring-gull dealing with a downy puffin) we dedicate to the conversion of those who favour the protection of the larger gulls. We dare not begin to quote for fear of never ending, and must confine ourselves to this one sentence in explanation of the plate: "I saw another kittiwake being savagely murdered by another herring-gull." The chapters on seals are very interesting, for few people have the chance of watching these animals. A good index is a great advantage to the reader, not always found in books of this kind.

FIG. 1.—Oyster-Catchers. From "Nature-Tones and Undertones."

A considerable part of Mr. Boraston's new work is occupied by an account of a remote and little known corner of Anglesey, and it is saying a good deal to say that this is perhaps the pleasantest and most interesting part of the book. How he journeyed there—and back—and what birds and other things he saw is told in the attractive and distinctly original style so much commended in the notices of his former work. Of more highly scientific interest, perhaps, is the series of careful notes which the author made upon a young cuckoo. These include several important observations which must not be detailed here; but we cannot refrain from quoting the author's concluding reflections on the strangely ferocious fledgling he watched so patiently. "And knowing it for a solitary and a wanderer beyond any of its kind, smuggled into life in an alien nest, tended in blind devotion by creatures it requites as blindly by destroying their own offspring; fashioned like a hawk to be hunted by every chit that flies; never to mate, never to nest, never to rear or lead its young; remembering this, I could have wished that this Unnatural Selection had not been, or that this strange mockery of life might be undone." In this chapter, too, we have an interesting inquiry into the theory of the assimilation of the cuckoo's eggs to those of the foster-species, with an analysis of collections of more than seventy nests of various birds containing cuckoos' eggs and the eggs of the foster-parents. The author writes, "The variation exhibited in the collections I have seen was considerable, but I could in most cases have improved the assimilation by transferring the eggs from one nest to another. Unless more convincing evidence were brought forward than such as was furnished by the seventy-six nests mentioned above, I should con-

clude that cases of resemblance between cuckoos' eggs and those of the species in whose nests they are deposited, are due to coincidence rendered possible by a large degree of variation in the former." Although digressions are not announced on the title, the latter is wide enough to cover many things, and many odd bits of out-of-the-way knowledge are woven into this book, which is mainly concerned with birds. A rather bitter attack on game preservers and sportsmen (with a slap at the army dropped in) is sandwiched between some most charming studies of wild life and natural scenery, written in clear and powerful and often quaint and humorous style. When has the barn owl been more aptly described than in this passage? "Never a sound from wing or throat as it flaps or skims in the half-light, watching the ground with its cat's eyes as it goes, until suddenly the silence is startled by a single, rasping yell such as might make the hair stand on the back of every mouse for a quarter of a mile around. The Arch-mouser is on the trail, and such a master of his craft that he appears at times to toot his horn in contempt of his quarry. Or, is this sudden shriek used to start any mouse that may be lurking below, so that when moving it may be more readily discerned?" Mr. Boraston, too, sometimes wants to know why. The eighteen photographs which illustrate this nicely got up volume are almost beyond praise. We have selected this one for reproduction, not because it is by any means the most beautiful, but because of the cleverness with which the whole of this rock, with its seaweed and its oyster-catchers, has been focused; it will appeal strongly to those who love our west coast and its birds. The whole book will be welcomed and treasured up by the great fraternity of British bird-men.

O. V. APLIN.

STUDIES OF CLOUDS.[1]

MR. CLAYDEN'S work will be a standard one for all students of clouds. When the now international classification was first proposed by the late Ralph Abercromby and the present writer, our purpose was to devise a classification for common use at all meteorological stations and in all the navies of the world. It is evident that such a classification must be simple and practicable. A great number of forms must lead to constant errors when used by ordinary observers. Therefore we only proposed the ten types given now in the international cloud atlas.

We were well aware, however, and expressed the view in plain words, that these ten forms are not sufficient for special studies of the transformation of clouds or of the relations between cloud form and weather. For these cases each of the ten great types must be divided into several subspecies, to which proper names must be given.

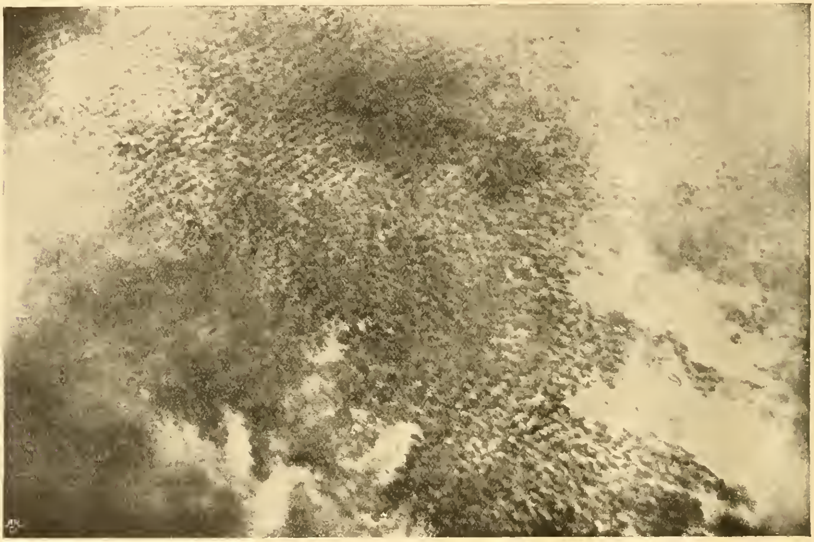


FIG. 1.—Cirro-nebula changing to cirro-cumulus. From "Cloud Studies."

Various attempts have been made to extend the scheme in this way. Abbé Maze in France, Prof. Köppen in Germany, the Rev. F. L. Odenbach in America, and, above all, the Rev. Clement Ley in England, have proposed and defined more detailed classifications; and Mr. Clayden has now in his cloud studies taken a great step forward in this direction.

The descriptions and the illustrations reproduced from photographs are excellent, and everyone who is accustomed to observe the ever-changing panorama of skies will admire the large amount of exact observations given in this book. The book contains reproductions of many typical cloud-forms and certain intermediate forms showing the transformation of one cloud-form into another.

[1] "Cloud Studies." By Arthur W. Clayden, M.A. Pp. xiii+184; 61 plates. (London: John Murray, 1905.) Price 12s. net.

It is important to notice that the author accepts the types of the international cloud atlas and arranges his various forms as subforms of these types. There is, however, one exception. Mr. Clayden does not admit the nimbus cloud as a special type, but puts it under the type stratus. He employs nimbus as an adjective indicating that rain is falling from a cloud. We cannot agree with this plan. Every form of cloud can be transformed into another. It is, indeed, well known that the true typical forms are rare, the majority of clouds being intermediate forms. Of course, it often happens that stratus cloud is transformed to nimbus. The farmer in Sweden says, "if the fog is falling the weather will be fine, if the fog is lifting it comes back as rain." It is really the case that in certain weather conditions the fog follows the upward motion of the air; in the rising air the temperature falls, condensation goes on, and the light fog is transformed to a dense nimbus with rain.

FIG. 2.—High Cirrus (*Cirrus Excelsus.*) From "Cloud Studies."

Nevertheless, there is a vast difference between the fog formed on or near the ground and the true canopy of nimbus cloud rushing forward beneath a layer of alto-stratus in the front of a storm. But here, as always, one form does sometimes pass into another. The alto-stratus does also sometimes sink down and become transformed into nimbus. We know that during summer all low clouds, as a rule, assume more or less the cumulus form. Thus we cannot say that a stratus or an alto-stratus is a nimbus more than that a stratus or a nimbus is a cumulus.

It is not possible to give in this short notice a description of the different forms presented in this book. We must also abstain from an exposition of the author's views regarding the causes which produce the different cloud forms. These views are in most cases highly probable, and in all cases useful hints are given for further investigations. Our purpose now is only to direct the attention of our fellow-students of clouds to a work of the greatest value, which should be studied with the greatest care. No one who desires to study the transformations of clouds or the relation of cloud forms to weather can neglect to consider the valuable results and ideas put forward by Mr. Clayden.

Of course, it is not possible for an international committee or conference to establish a very detailed classification of clouds, but we think it would be very useful if the author would provide the plates and short descriptions as a small atlas for use in observatories and for specialists.

H. HILDEBRAND HILDEBRANDSSON.

TRANSPACIFIC LONGITUDES.

DURING the year 1903 Canada extended the longitude work, carried from Greenwich to Vancouver, across the Pacific to Australia and New Zealand. This was made possible by the completion of the British Pacific Cable—the All Red Line—in the autumn of 1902. The sections of the cable are :—

	Nautical miles
Vancouver to Fanning Island...	3654
Fanning to Suva, Fiji...	2181
Suva to Norfolk Island...	1019
Norfolk to Southport, Queensland	906
Southport to Doubtless Bay, New Zealand...	513

The observers (Dr. Otto Klotz and F. W. O. Werry) were provided with practically identical instruments, the principal ones being the two Cooke transits, of 3 inches clear aperture, and of about 36 inches focal length. Cement or brick piers were built at every station. The observers occupied alternate stations across the Pacific, and as the number of stations is odd, Southport and Doubtless Bay are free from the personal equation, without a direct determination of the latter, although the personal equation was determined. Mr. Werry occupied Fanning and Norfolk,

the writer the other stations, including Sydney, Brisbane, and Wellington for personal equation. At Southport connection was made with the observatories at Sydney and Brisbane, and from Doubtless Bay with Wellington.

It was on September 29, 1903, that the first mutual observations and clock exchange were had with Sydney, and so this night may be considered as the one when for the first time longitude from the west clasped hands with longitude from the east, and the first astronomical girdle of the world was completed.

In making the comparison at Sydney between the longitude brought from the east with that from the west, I have used the value of Prof. Albrecht for the arc Greenwich-Potsdam 0h. 52m. 16·051s., and for the arcs from Potsdam to Madras, *viâ* Teherân, Bushire, Karachi, Bombay, and Bolaram, those of Major Burrard, giving for the longitude of Madras 5h. 20m. 59·235s.

As there has been no re-determination of the various arcs from Madras to Australia, I have adopted the values given in the Australian report of Ellery, Todd and Russell.

Applying these latter to the longitude of Madras, we get for the longitude of Sydney

	h. m. s.		s
	10 04 49	...	0·355 ± 0·088
The Canadian value is	10 04 49	...	0·287 ± 0·058
Difference	... ...	...	0·068

equivalent for the latitude of Sydney to 84 feet. The 1886 value for Sydney is 10h. 04m. 49·54s.

The final values of the Canadian determinations are :—

Final Longitude Values.

Station	Longitude			
	Time	Prob. error	Arc	Prob. error
	h. m. s.	s.	° ′ ″	″
Vancouver . .	8 12 28·368 W.	±0·050	123 07 05·520	±0·75
Fanning . . .	10 37 33·774 W.	±0·054	159 23 26·610	±0·81
Suva	11 53 42·389 E.	±0·055	178 25 35·835	±0·82
Norfolk . . .	11 11 41 146 E.	±0·056	167 55 17·190	±0·84
Southport . . .	10 13 39·782 E.	±0·056	153 24 56·730	±0·84
Sydney	10 04 49·287 E.	±0·058	151 12 19·305	±0·87
Brisbane . . .	10 12 06·044 E.	±0·073	153 01 30·660	±1 09
Doubtless Bay .	11 33 56·146 E.	±0·060	173 29 02·190	±0·90
Wellington . .	11 39 05·087 E.	±0·075	174 46 16·305	±1·12

OTTO KLOTZ.

Ottawa, December 30, 1905.

THE KANGRA EARTHQUAKE OF APRIL 4, 1905.

AFTER a lapse of only eight years since the great earthquake of 1897, India suffered another calamity of the same nature on April 4, 1905, less in violence and extent, but more calamitous in its results, for it claimed a death-roll of 20,000 souls. An interesting preliminary account of this earthquake, by Mr. C. S. Middlemiss, appears in the concluding part of vol. xxxii. of the *Records of the Geological Survey of India*, where the total area over which the shock was felt is estimated at about 1,625,000 square miles, as against 1,750,000 in 1897. The area over which the shock was destructive is smaller in proportion than these figures would suggest, for the isoseist corresponding to 10 degrees of the Rossi-Forel scale includes only 200 square miles, and that corresponding to 8 degrees of the same scale 2150 square miles, as against 300 and 145,000 in 1897. In comparing these figures an allowance must be made for the personal equation, and it seems that, if Mr. Middlemiss's standard had been adopted in 1897, the former of these figures would have been considerably increased and the latter somewhat reduced.

There were two centres of great violence, one near Kangra and Dharmsala, where the tenth degree of the Rossi-Forel scale was surpassed, the other in the Dehra Dun, where the ninth degree was not reached. Between these two the violence was much less, and Mr. Middlemiss points out that the two districts of greatest destruction lie, each, in an embayment of the course of the great boundary fault of the Himalayas; they are the only two irregularities in the generally even sweep of the boundary of the Tertiaries of the sub-Himalayan tract, and as the general effect of the Tertiary, and post-Tertiary, folding and fold-faulting has been to obliterate irregularities in the outline of the mountain-foot, it is natural to suppose that any marked irregularities still left may be in a peculiar state of strain, especially liable to give rise to geotectonic movements. Those which took place on April 4 last seem to have exhausted themselves underground, for no surface faults or changes of level were detected.

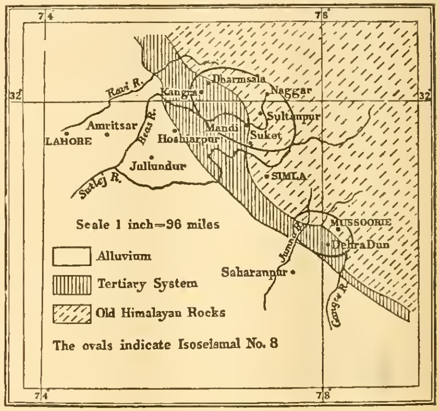


FIG. 1.—Origin of the Kangra earthquake of April 4, 1905.

The nature of the shock seems to have differed from that of 1897, when all accounts agreed in describing it as simple, with only one marked maximum of violence. In 1904 there were, both in the Kangra and Dehra Dun districts, two or three distinct shocks, and we may mention that this is reflected in the long-distance records of the shocks, which indicate at least two distinct impulses, following each other at an interval of a couple of minutes, whereas in 1897 there was no indication of more than a single impulse. The violence of the shock at its greatest seems to have been a little less than in 1897; at Kangra Mr. Middlemiss's observations give the acceleration of wave particle as about 13 feet per second per second, the amplitude as 9·75 inches, and the period as 1·57 seconds. The time of origin, as deduced from local observations, is said to have been 6h. 9m. 0s. Madras time, within a second or two of error; the rate of propagation was 1·95 to 1·98 miles per second as between the origin and the seismograph stations at Bombay, Calcutta, and Kodaikanal, but it must be

remarked that this rate refers to the large motion on the Milne seismographs, not to the felt shock, the discussion of which is deferred to the larger memoir promised.

Among miscellaneous effects of the earthquake it is mentioned that in some cases the flow of springs was more or less completely checked, while others increased or broke out in new places. In Sind and Burma the shock was not felt, but affected the bubbles of level tubes during survey operations, the movement in the former district indicating a surface tilt of about 30 seconds of arc above and below the horizontal, in a north-east-south-west direction.

HENRY JAMES CHANEY.

On February 13 Henry James Chaney, who for more than forty years was an authority on our standards of weight and measure, ended his lengthy official career at Hampstead after a painful illness of some months' duration.

He was born at Windsor in March, 1842, was educated privately, and entered the Civil Service at an early age. In 1860 he was appointed to the Exchequer, the department in which at that time the statutory powers with respect to weights and measures were vested. Here he had the good fortune to come into contact with Airy and Miller, who had just completed their researches, undertaken at the instance of the Government, in connection with the restoration of the Imperial standards. Profiting by their advice and encouragement, he devoted himself with much zeal to the technical duties which were imposed upon his department by the Sale of Gas Act, 1859. Under the direction of H. W. Chisholm, the Warden of the Standards, he took an important part in perfecting the official apparatus for verifying gas-measuring instruments. He acted as secretary to the Standards Commission, 1867–71, and had much to do with the preparation of the voluminous appendices to its reports.

On the abolition of the separate office of Warden of the Standards in 1878, Mr. Chaney was placed in charge of the Standards Department of the Board of Trade. As superintendent of weights and measures he was responsible for the model regulations with respect to weights and measures on which the local regulations throughout the country have been based. He was for many years the representative of the United Kingdom on the Comité International des Poids et Mesures, and took an active share in its proceedings. When the metric system of weights and measures was made permissive in this country in 1897, Mr. Chaney compiled the new tables of metric equivalents which were legalised the following year by Order in Council.

Mr. Chaney's scientific writings are for the most part to be found in the periodical publications of the Standards Department, and include, *inter alia*, "Report on the Standards of Measurement for Gas," "Verification of Standards for the Governments of India and Russia" (1877), "Screw Gauges" (1881–3), "Densities and Expansions" (1883), "Expansion of Palladium," "Re-comparison of the Imperial and Metric Units" (1883), "Verification of the New Parliamentary Standards of Length and Weight" (1881–3). His "Re-determination of the Mass of a Cubic Inch of Distilled Water" (Phil. Trans., 1892), which was intended to serve as a basis for calculating the relation between measures of capacity and volume, gave for the cubic contents of the gallon the value 277·463 cubic inches, a much better approximation than the value 277·274 cubic inches, due to Kater, which was accepted up to that date. The researches which have since been undertaken at the Bureau International des Poids et Mesures, and are still in progress, have yielded a provisional result for the mass of a cubic decimetre of distilled water at its maximum density which leads to the value 277·420 cubic inches for the cubic contents of the gallon. This does not differ much from Chaney's result, and is to be considered as the best determination up to date.

His well known work "Our Weights and Measures," which appeared in 1897, contains a mass of metrological information not readily accessible elsewhere. One of his latest contributions to science was the article "Weights and Measures" in the supplement to the ninth edition of the "Encyclopædia Britannica." His last official publication was a report on the "Construction and Verification of a New Copy of the Imperial Standard Yard" (1905).

His great experience in precise measurement caused him to be regarded as a valuable cooperator, and his advice was frequently sought by official committees. The Imperial Service Order was conferred upon him in 1902, and the services rendered by him in connection with the restoration of the Russian standards of weight and measure were recognised by the present Tsar as well as by his grandfather, Alexander II.

Mr. Chaney's name has long been familiar in metrological circles, and his death has removed another link with the past. The memory of his kindly disposition and ready assistance will be treasured by all those who were in any way associated with him.

NOTES.

We are informed that the council of the Royal Society has selected the following candidates for election as fellows of the society:—Dr. C. W. Andrews, Mr. G. T. Beilby, Mr. F. F. Blackman, Prof. T. J. I'Anson Bromwich, Mr. P. H. Cowell, Mr. W. Heape, Mr. J. H. Jeans, Dr. C. H. Lees, Captain H. G. Lyons, R.E., Prof A. B. Macallum, Mr. J. E. Marsh, Dr. P. Chalmers Mitchell, Mr. J. Swinburne, Prof. H. A. Wilson, Prof. A. E. Wright.

A meeting was held at the Mansion House on Monday, the Lord Mayor presiding, to consider what steps should be taken to commemorate the discovery by Dr. W. H. Perkin fifty years ago of the first artificial colouring matter obtained from a coal-tar product, and to celebrate the great development of the coal-tar colour industry thus started. A note describing the origin and nature of the movement appeared in these columns on February 15 (p. 370). The proceedings at Monday's meeting were opened by Lord Halsbury, who moved:—"That, in view of this being the fiftieth year of the foundation of the coal-tar colour industry, it is desirable that steps should be taken to memorialise the event and to do honour to Dr. W. H. Perkin, the founder." Sir William Bousfield seconded the motion, which was supported by the Master of the Leathersellers' Company and Prof. H. E. Armstrong, and unanimously carried. Lord Rayleigh moved:—"That an appeal be made in this country and abroad for subscriptions for the purpose of carrying out the following objects:—(1) The presentation to Dr. Perkin for his lifetime of an oil portrait of himself, executed by an eminent artist, the portrait to become the property of the nation at his death. (2) The execution of a marble bust of Dr. Perkin to be placed in the rooms of the Chemical

Society. (3) The establishment of a 'Perkin Research Fund' for the promotion of chemical research to be administered through the Chemical Society." This resolution, which was also adopted, was seconded by Sir William Ramsay, and supported by Sir Henry Roscoe and Mr. David Howard. It is unnecessary here to detail the steps in the growth of the German coal-tar colour industry which is the commercial outcome of Dr. Perkin's discovery—an industrial development by which this country might have been expected to benefit. But, as a correspondent writes in the *Times* of February 24:—"Although in this country there have never been wanting capable chemists able to carry on and extend the manufacture of colouring matters, there has been complete lack of understanding on the commercial side of the complex requirements of the industry and complete lack of sympathy between the capitalist and the scientific worker. The failure must be credited to our universities and to our faulty system of higher education—to our inbred Philistinism. Little, if anything, has been done either in school or university to evoke in the community even an elementary understanding of the principles of science and of their application to commerce and industry. We are now paying the penalty of our neglect." To secure that the nation shall derive full industrial value from scientific discoveries will be possible only when we have developed a system of secondary and higher education in which modern needs and modern methods are recognised; for not until then will there be among us a generation of employers and capitalists able to understand expert opinions and with scientific imagination enough to read the signs of the times.

THE encroachments of the sea on parts of our coasts, and the question of national responsibility for the protection of the seaboard against such erosion, was raised in the House of Commons on Monday in an amendment to the Address. Several members urged that the Government should give financial assistance for the construction of works for coast protection and afford facilities to local authorities for obtaining loans on easy terms for the defence of the sea coast. The President of the Board of Trade stated that the Government has decided to have an inquiry in the form of a Royal Commission, which will extend not merely to coast defence, but to two or three other kindred subjects, such as waste lands and probably afforestation. A Commission will be appointed at an early date to inquire into the matter. Some objections to the expenditure of Imperial funds upon the protection of private property at sea-side resorts and other localities were stated in an article in NATURE of February 15 (p. 309).

SEVERAL years ago a commission was appointed by the Imperial Academy of Sciences of Vienna to collect phonographic records to be preserved for scientific study. Some of the results obtained by expeditions to Kroatia, Slavonia, and Lesbos were described in NATURE of January 29, 1903 (vol. lxvii., p. 301). The Vienna correspondent of the *Pall Mall Gazette* now states that from North Tyrol and Vorarlberg fifty-seven specimens of German dialects have been obtained for the archives, and another forty-seven from Carinthia. From New Guinea have been sent thirty-two phonographs recording the language and music of the natives, with especially interesting war songs and the accompanying drum music. From India have been received valuable records of old Sanskrit songs. An expedition which was sent out to Australia is now on its way back, and another party is about to start for Greenland.

IT is stated that the new director of the Vatican Observatory will be Father J. G. Hagan, S.J., professor of astronomy in Georgetown University, U.S.A., and director of the observatory there.

IN connection with the indication by the London County Council of houses in London which have been the residences of distinguished individuals, a memorial tablet was erected on Monday on No. 110 Gower Street, where Charles Darwin resided from 1839 to 1842.

MR. E. T. WHITTAKER, F.R.S., has been appointed Andrews professor of astronomy in the University of Dublin, in succession to the late Prof. C. J. Joly, F.R.S. The appointment carries with it the office of Royal Astronomer of Ireland.

A REUTER message from Paris states that the committee of the Alliance Française-Britannique received at the Sorbonne on Monday the delegates of the London branch of the Alliance, headed by Sir Archibald Geikie, F.R.S., the chairman. M. Liard, Vice-Rector of Paris University, and M. Levasseur, director of the Collège de France, and honorary president of the Alliance Française, welcomed the British delegates. After Sir Archibald Geikie had delivered an address on geology, the British guests visited the laboratory and the large amphitheatre of the Sorbonne. In the evening they were present at a banquet given in their honour, the Minister of Public Instruction being in the chair.

WE learn from the *British Medical Journal* that the next meeting of the Congress of Experimental Psychology will be held at Würzburg, April 18–21. Among the communications promised are the following:—Dr. F. Krüger, on the relations between experimental phonetics and psychology; Prof. O. Külpe, on the present position of experimental æsthetics; Dr. F. Schumann, on the psychology of reading; Prof. R. Sommer, on psychiatry and the psychology of the individual; Dr. W. Weygandt, on the psychological investigation of congenital feeble-mindedness. Communications relative to the congress should be addressed to Prof. O. Külpe, Würzburg.

ABOUT two years ago steps were taken to erect a fitting memorial to James Watt at his birthplace. This is to take the form of a commemorative public building and statue at Greenock. In the *Engineer* of February 23 disappointment is expressed that an object so obviously worthy, and an appeal so influentially prosecuted, should not have had greater success. Only 700*l*. has been subscribed in Great Britain and 190*l*. in America. Influential canvass, nevertheless, was made by Mr. Carnegie in the United States, while in Great Britain Dr. Robert Caird sent out 10,000 circulars inviting subscriptions. The balance required, 9300*l*., has been contributed by Mr. Carnegie.

ORNITHOLOGY has lost its oldest votary by the death, on February 20, of Prof. Jean Louis Cabanis, for many years in charge of the collection of birds in the Museum of Berlin. Born in 1816, his earliest work of importance seems to have been the ornithology of Tschudi's "Fauna Peruana" in 1845 and 1846. He afterwards did the same service for Sir Richard Schomburgk's "Reisen im Britisch-Guiana"; but the "Ornithologische Notizen" in the *Archiv fur Naturgeschichte* for 1847 almost marked a new epoch in the progress of the science, for they were written in conjunction, it may be said, with Johannes Müller, and practically applied the principles of taxonomy laid down by that great anatomist, in his contributions to the Academy of Sciences in Berlin in 1845 and 1846, On certain variations in the vocal organs of the Passeres—

a line of investigation so well worked out subsequently in this country by Garrod and Forbes. In 1853 Cabanis established the *Journal für Ornithologie*, of which he remained editor until succeeded in 1893 by his son-in-law, Prof. Reichenow, and with that journal—the prototype of the *Ibis*, and hence of several others—his name will be ever associated. The "Museum Heineanum" is another work by which he will be remembered; but the above-mentioned "Ornithologische Notizen" must be regarded as by far his greatest performance, and, of course, they excited no attention in this country for many years.

MR. MORTEN P. PORSILD informs us that during the summer of the present year a permanent station for the study of Arctic science will be established on the south coast of Disco Island, in Danish West Greenland. The cost of the foundation is to be defrayed by a gift from Mr. A. Holck, of Copenhagen, and the Danish Government has promised an annual grant of 600*l.* towards its maintenance. A laboratory, equipped with appliances and instruments, especially for biological researches, will be attached to the station, and work-places will be furnished for visiting naturalists, foreign as well as Danish. The establishment of two such places is contemplated at present. The visitors will be allowed free use of instruments, travelling outfit, and library of the station; lodging will be free, and a small fee only will be charged for board. The first visitors will be received in 1907, and notices, inviting application, will be issued in due course. A library of Arctic literature is to be founded at the station, and is to be made as complete as possible. Mr. Porsild, the leader of the station, whose address until May 1 next is Copenhagen, S., Denmark, will be glad to receive presentation copies of works on Arctic and Antarctic subjects, especially on Arctic biology, for addition to the library.

MR. BALFOUR proposed the toast "The School and Union" at the annual dinner of the Students' Union of the London School of Economics and Political Science held on February 24. Answering the question, What is it we mean by economics in its wider sense? Mr. Balfour spoke of the scientific character of the study of economics, and went on to say:—"Science, if it means anything, means a progressive knowledge, and I confess I detest the habit of the unreasoning appeal to authority, especially when, as is often the case, the authority is somewhat antiquated. In science there is, or ought to be, no such thing as authority whatever. A man of science builds, and gratefully builds, on the foundations left by his predecessors; but they are but foundations. It is his business to raise tier after tier the fabric of ever-progressive knowledge." Later Mr. Balfour said he desired to see the school "inspired with that detached and disinterested scientific spirit which is, after all, the true origin of all progress in this world." We note with pleasure this frank recognition of the value of the scientific spirit in all branches of learning and in every department of enterprise by a great politician, and we look forward to the time when every human activity in this country will be governed by the methods of science and imbued with its spirit.

DURING the past few days the following reports of seismic disturbances have appeared in the daily papers:—*February* 21.—Shemakha (Government of Baku), Earthquake was felt at 12.10 a.m. Fort de France, Earthquake shock was felt at 12.13 p.m. St. Lucia, Severe earthquake occurred at 8.30 p.m. Other shocks were afterwards felt at frequent intervals. Mont Pelée, Martinique, is active. At Fort de France many houses have been demolished by earthquakes. La Soufrière, the St. Vincent volcano, is more active than it has been since 1902. Buenaventura, Colombia, Earthquake lasting seven minutes occurred at 10.35 a.m., the movement being from north to south. After the earthquake there was a huge wave, which was of no consequence at Buenaventura; but according to reports from the coast so far as 50 leagues to the south, 2000 persons were killed by falling houses or drowned by the wave, whole families being lost.

ACCORDING to the *Chemiker Zeitung*, the General Electrical Company, of Berlin, in conjunction, it is said, with the firm of W. C. Heraeus, of Hanau, intends to start a company for the production of mercury lamps made out of quartz glass.

ON February 10 Prof. van 't Hoff gave a lecture on thermochemistry before a large gathering of members and guests of the Austrian Engineers' and Architects' Society in Vienna. After a few preliminary remarks on the heat of reaction and combination of chemical substances and their calorimetric measurements, Prof. van 't Hoff dwelt upon the heat of alcoholic fermentations, of thermite decomposition and of various illuminants, pointing out the great amount of heat developed in the decomposition of acetylene and the pressure developed in explosions, and finally discussed the relations between heat development and chemical affinity, referring at length to Berthelot's principle, which would find a measure of chemical affinity in the heat developed, but which Prof. van 't Hoff declared untenable. The lecturer concluded with the remark that this subject of thermochemistry was one in which a more general application of modern chemistry was most desirable; he was, however, of the opinion that it was the duty of the man of science to seek out new ways and to find out new laws, but that here his duties ceased, whilst the practical technical man must himself sort out that which was necessary and usable. After the lecture the leading chemists and physicists of Vienna entertained Prof. van 't Hoff to a dinner given in his honour.

As was mentioned in NATURE of February 1 (p. 322), the sixth International Congress of Applied Chemistry will be held this year in Rome from April 25 to May 3. It may be remembered that the first congress was held in Brussels in 1894, the second in Paris in 1896, the third in Vienna in 1898, the fourth in Paris in 1900, and the fifth in Berlin in 1903; a desire has been expressed that the seventh meeting should be held in England. All communications and applications for membership of the sixth congress should be addressed to the Ufficio del Congresso, Via Panisperna, 89, Rome. The subscription fee of 20 lire is to be forwarded by P.O.O., made payable to Prof. Giovanni Giorgis, the treasurer of the congress. Upon application a pamphlet will be forwarded containing all information requisite for applicants, together with the regulations of the congress, a list of Italian and foreign committees, a list of the sections, and the titles of papers and communications that have been announced up to the present. The English committee contains some thirty-three names of representatives of fifteen leading scientific societies connected with chemistry, including the Royal Society, the Chemical Society, Society of Chemical Industry, Society of Public Analysts, the Iron and Steel Institute, the Faraday Society, the Institute of Chemistry, &c. In addition to the sectional meetings, which are to take place on April 27, 28, and 29, and on May 1 and 2, lectures of a general nature will be arranged (such lectures by Profs. H. Moissan, Sir W. Ramsay, and O. N. Witt

are announced), a social gathering of the members will take place on the evening of April 25, an excursion in the neighbourhood of Rome will be made on Sunday, April 29, and two alternative excursions, the one to Sicily and the other to the Island of Elba, to places of chemical interest on May 3; as the number of participators in the latter is limited, preference will be granted to those who are first to send in their names, and more especially to foreign members. Members may further obtain a reduction of 40 per cent. to 60 per cent. on the Italian State Railways, and 60 per cent. on tickets issued by the navigation companies Navigazione Generale Italiana and La Veloce. The papers to be contributed will be grouped in eleven sections, and may be in one of the four official languages of the congress, namely, Italian, French, German, and English. The discussions after the reading of the papers may also be carried on in one of these languages.

Museum News for February records the addition to the Brooklyn Museum, New York, of a skeleton of the sperm-whale, measuring 47 feet in length, which has been suspended to the roof of the building.

In the *American Journal of Science* (February) Mr. C. C. Trowbridge re-opens the disputed question of the interlocking of the emarginate primary flight-feathers in raptorial birls, adducing apparently conclusive evidence that this takes place in certain American hawks, with a resulting increase of wing-power.

The contents of vol. lxxx., part iv., of the *Zeitschrift fur wissenschaftliche Zoologie*, comprise a paper by Dr. E. Strand, of Christiania, on the structure and development of spiders; a second, by Mr. J. Wilhelmi, on the excretory organs of the fresh-water turbellarian flatworms of the section Tricladida; and a third, by Dr. C. Hennings, of Rostock, on the "tömövarysche" organ in myriapods. The latter is the continuation of a paper the first part of which appeared in the same journal in 1904. A systematic classification of the myriopods is given.

In the report of the Maidstone Museum, Library, and Art-Gallery for 1905 is published a photographic reproduction of an original drawing by the late Mr. W. H. Bensted of the well known slab (now in the Natural History Museum) containing a large portion of the skeleton of a young iguanodon, obtained by him from the ragstone quarry in Queen's road, Maidstone, in 1834. The drawing is, of course, mainly of historical interest. An offer of the loan, for an indefinite period, of an exceedingly valuable, and in this country almost unique, collection of Japanese pottery, made by the Hon. H. Marsham, has been accepted by the museum authorities.

The January issue of the *Emu* contains an excellent portrait of the late Captain F. W. Hutton. From the report of the proceedings of the fifth session of the Australasian Ornithologists' Union, held at Adelaide, which appears in this number, we learn that the acting president devoted his address to the subject of European and other birds introduced into Victoria. The two species that have thoroughly established themselves are the starling and the sparrow. No one appears to have a good word for the latter, but as regards the former it is stated that the residents in Riverina are longing for its arrival in numbers to help them to cope effectually against the armies of locusts and caterpillars that frequently infest those districts. Thrushes, blackbirds, and greenfinches have established themselves to a small extent in and around the districts where they were first liberated, but chaffinches, yellow-hammers, and siskins have practically failed to accommodate themselves to their new surroundings.

In discussing the early stages of the Palæozoic rugose corals, as a clue to the origin and relationships of the group, Mr. C. E. Gordon, in the February number of the *American Journal of Science*, finds himself unable to accept Mr. Duerden's views as to the close connection between the ancient tetrameral and the modern hexameral types of corals. On the contrary, he is of opinion that we are not yet in a position to define their relationships or to state which is the earlier of the two. In a second paper in the same journal Mr. C. R. Eastman discusses the affinities to the lung-fishes presented by the group of armoured Palæozoic fishes typified by Coccosteus, and commonly known as the Arthrodira. From the study of the North American genera Dinichthys, Dinomylostoma, &c., the author comes to the conclusion that the alleged relationship is well founded, thus confirming the views of Dr. A. Smith Woodward. The author goes, however, somewhat further, and urges that while the living Australian *Ceratodus* (*Neoceratodus*) *fosteri* bears an intimate relation to Arthrodira on the one hand, and to the Palæozoic Dipterus and its allies on the other, yet that it is a more primitive type than any of these. It represents, in fact, the direct line of descent from primitive Palæozoic Ceratodonts, from which Dipterus and its allies diverged in one direction and the Arthrodira in the other. Hence the Dipnoi cannot be descended from the crossopterygian ganoids, but are more probably derived from Pleuracanthus-like sharks. Further, the association of the Arthrodira with the Ostracophora (Pterichthys) in one group, Placodermata, becomes obviously impossible. Mr. R. S. Lull points out that the name Ceratops proposed by Marsh for the Laramie horned dinosaur is preoccupied, and he accordingly suggests the new name Proceratops, with Agathaumidæ as the family title.

The *Pioneer Mail* remarks that the immunity of Europeans continues to be one of the most noticeable features of the plague epidemic. Last year, in the Bombay Presidency, where the disease carried off more than a quarter of a million people, only nineteen Europeans in all were attacked, of whom ten died. In the previous year, in the same region, where 316,000 deaths took place, only eight were amongst Europeans.

Mr. A. Elenkin, writing in the *Bulletin du Jardin impérial botanique*, St. Petersburg (vol. v., part v.), on the marine algæ found near the biological station at Mourmane, discusses the different forms of Lithothamnin, and describes a new species characterised by the development of bicellular spores.

In recording his impressions of the botanical congress at Vienna in the *Bulletin de l'Académie de Géographie botanique*, Mr. L. Navas, who represented the Société Aragonaise des Sciences naturelles, presents his arguments in favour of giving the authority for the genus and not the authority for the binomial name of a plant.

A periodical bulletin—*Le Bambou*—devoted to the study of the bamboo, its cultivation and uses, has been started by Mr. J. H. de Lehaie, Mons, Belgium. The first number, published January 15, contains an article on the flowering and seeding of bamboos in Europe. From a study of the collated data, the writer concludes that in the section Arundinaria the majority of species flower gregariously, produce seed and die, but in the case of Phyllostachys the production of seed does not appear to be the harbinger of death.

IN addition to the descriptions of a number of Indian forest fungi that Dr. E. J. Butler has been contributing to the *Indian Forester* (October to December, 1905), some of his remarks possess a more general interest. In connection with the genus Chrysomyxa, a heterœcious species in Europe produces teleutospores on rhododendrons and æcidia on the spruce. In India, both æcidial and teleuto stages of a Chrysomyxa have been found on *Rhododendron campanulatum*, thus giving grounds for an assumption that Chrysomyxa was originally confined to a single host. Dr. Leather also makes some definite statements on the subject of wheat rust, *Puccinia graminis*, and the æcidial stage that occurs on the barberry. In India, the stages on the wheat do not seem to depend upon the presence of barberry bushes, as the most destructive areas of rust were hundreds of miles distant, and, further, at the only part of the Himalayan range where *Accidium berberidis* is known to occur black rust is extremely rare on cereals.

IT has always been recognised that there is an uncertainty as to the plant that yields the Manila Elemi of commerce. Trimen and Bently, in "Medicinal Plants," referred it to a species of Canarium allied to *Canarium commune*, and later writers have generally referred it to that species. Mr. E. D. Merrill, the botanist in the Philippine Islands, with specimens before him of fruit, flowers, and the pitch locally known as "brea," assigns it to *Canarium luzonicum* in Publication No. 29 of the Bureau of Government Laboratories. Other species of Canarium yield brea, but, according to the writer, do not furnish the article of commerce. The same publication contains the third list of new or noteworthy plants that Mr. Merrill has identified. It includes a number of new species of Medinilla and Rhododendron; of the fourteen species of Rhododendron, thirteen are believed to be endemic.

IN a note contributed to the *Atti dei Lincei*, xiv. (2), 12, Dr. G. Noè discusses the functions of the remarkable organs of sense first discovered by Hicks in 1857 on the wings of many species of Diptera.

IN the *Memorie* of the Italian Spectroscopists' Society, xxxiv., 6, Messrs. A. Mascari and A. Cavasino discuss the effect of atmospheric disturbances on the outline of the sun's disc, with special reference to the direction of the wind and other meteorological conditions.

MEMBERS of the recent British Association party will remember enjoying English salmon for dinner one day on the voyage home from Beira. This reminiscence is suggested by a note in the *Revue générale des Sciences* from which we learn that an undertaking has successfully been carried out for obtaining in Paris fish from the French fisheries on the west coast of Africa, transported under cold storage.

IN connection with Prof. Sydney Hickson's article on "Miners' Worm" (February 8, p. 344), attention may be directed to a paper by Gino Peri in the *Atti dei Lincei*, xiv. (2), 12, dealing mainly with the question as to how far *Ankylostoma duodenale* is parasitic on animals other than man. The author has succeeded in infecting dogs through the mouth and by penetration of the skin, and there are good reasons for believing that horses are also liable to infection.

M. GEORGES CLAUDE describes in the *Journal de Physique* a series of apparatus for the separation of oxygen and nitrogen by the liquefaction of air. In these the necessary degree of cold is obtained by expansion accompanied by performance of external work, and the process of separation depends on the small difference between the boiling points of oxygen and nitrogen. The whole apparatus is of a compact form, and of two examples in actual working at Boulogne-sur-Seine, one is capable of generating 700 and the other 1000 cubic metres of 96 to 98 per cent. oxygen per diem.

THE *U.S. Monthly Weather Review* for September last contains a graphic account of a tornado of marked severity which visited Carbondale, Pennsylvania, on August 30, 1905. Mr. W. M. Dudley, meteorologist in charge at Scranton, about sixteen miles distant, issued a circular of inquiry, and obtained special reports from neighbouring districts. From these it appears that a funnel-shaped cloud, from which vivid lightning played, moved across the northern portion of Carbondale in a south-west to north-east direction, covering a track two miles in length and from 25 to 200 yards in width. About thirty houses and other buildings were blown down, and some of the roofs were carried to a distance of 600 feet. The trees which were blown down fell to the eastward. The area affected was, as usual, very small, the storm being chiefly confined to the Carbondale district. At Scranton there was

FIG. 1.—A building which was moved in line with the direction of motion of a tornado on August 30, 1905.

vivid lightning, but no other special characteristics were observed; the barometer was low, reading 29·64 inches, but remained steady; there was no noticeable increase in the wind velocity, and very little rain fell. The passage of the cloud, which appeared to revolve in a backward direction, was accompanied by a heavy rumbling noise. The illustration, from one of the photographs taken, shows the effect of the storm on the buildings; the tornado occurred about 8h. 30m. p.m., but its duration is not stated.

M. CH. ED. GUILLAUME contributes to the *Revue générale des Sciences* for January 15 an interesting account of the career of Colonel Charles Renard, whose death took place in April of last year. From a popular point of view, Colonel Renard sprang into fame in 1884–5 in connection with the successful trips made by the navigable balloon *La France*; but his scientific work covers a wider range than this series of experiments, his inventions dating from 1875, when he devised a new air-valve for balloons, up to within a short time of his death. Among other innovations we notice the introduction of the coefficient of

"laminage" in connection with problems of thermal conductivity between gases and solids; also improvements in the construction of boilers and surface condensers based on the same study, having for their object the construction of light motors for aërial navigation. Then, again, we find Renard turning his attention to portable hydrogen generators for military ballooning and pneumatic elevators for grain and other materials. Last, but not least, we have the motor train, exhibited in December, 1903, all the carriages of which were self-propelled by power transmitted from the motor through a series of jointed shafts. This train was successfully conducted round sharp corners through the streets of Paris.

The February number of *Symons's Meteorological Magazine* commences the forty-first volume of this useful periodical. It began as a two-page "Rain-circular," intended to keep rainfall observers in touch with each other's work; in 1866 it became an eight-page magazine, and has now gradually increased to twenty pages, and has attained, under the editorship of Dr. H. R. Mill, to the position of one of the most important monthly meteorological reviews published. Dr. Mill points out that the readers of the magazine frequently tender advice; although this cannot always be adopted individually, he has endeavoured to give effect to the principal desiderata put forward during the last few years. The chief result has been the introduction of a very useful additional table of fifty-four rainfall stations, giving the position and height above sea, and the statistics of rainfall and temperature for each month; it shows the value and date of the maximum and minimum temperature, and the number of nights at or below 32°, both in the shade and on the grass; the thirty years' average and the actual rainfall for the month, the greatest fall in twenty-four hours, and the number of rainy days, together with the mean annual fall. Following numbers will show, somewhat like the Weekly Weather Report of the Meteorological Office, the total rainfall from January 1 to the end of the month dealt with. This new table involves a considerable amount of additional labour, but greatly enhances the value of the publication.

A very interesting article on the uranium deposits of St. Joachimsthal is contributed by Dr. Paul Gaubert to No. 1 of vol. iii. of *Le Radium*. The article is illustrated by geological maps of the district and of the mines, and by two photographs of the town. The same number of *Le Radium* contains also a *résumé*, by Prof. G. Sagnac, of the experimental methods used in the study of the transformation of Röntgen rays.

The report of the International Committee on Atomic Weights for 1905 is published in the Proceedings of the Chemical Society (vol. xxii., No. 303). During the past year there was unusual activity in the determination of atomic weights, and some of the work done relates to the most fundamental values. The entire system of atomic weights is thus affected more or less profoundly, and a general revision would seem to be needed in the near future. In particular, the recent re-determinations of the atomic weights of chlorine, sodium, and nitrogen appear to show that the values obtained by Stas for these elements are now no longer tenable. Guye's work in connection with nitrogen has already been noticed in Nature (vol. lxxiii., p. 37). The other elements of which the atomic weights have been re-determined are cadmium, carbon, gadolinium, iodine, potassium, silicon, strontium, tellurium, and thorium.

Some interesting results have been obtained by Mr. Percival Lewis in studying the degree of ionisation in the gases resulting from coloured flames (*Physical Review*, vol. xxi., No. 6). The specific ionic velocity was measured in the case of a Bunsen flame into which solutions of known concentrations of various salts of the alkalis and alkaline earths were sprayed. The ionic velocity apparently varies in the case of each salt inversely as the square root of its concentration in the flame; the specific ionic velocity has, moreover, the same magnitude for ions of the same sign from equimolecular solutions of all the salts of all the alkali metals. The velocity of the negative ions is always somewhat greater than that of the positive ions. The measurements given show also that the rate of re-combination of the ions from the colourless Bunsen flame is much greater than that observed in the case of the coloured flames.

Prof. Henri Moissan in a recent paper gave an account of his experiments on the fusion and distillation of metals of the platinum group. In the current number of the *Comptes rendus* (February 19) he describes similar experiments on the metals of the iron group, the metals examined including nickel, iron, manganese, chromium, molybdenum, tungsten, and uranium. All these were distilled in the electric furnace, but the boiling points varied considerably. The most volatile proved to be manganese, which distils readily before the lime of the furnace is volatilised. Nickel is fairly easy to distil, then chromium, which distils with regularity under the action of a current of 500 amperes at 110 volts. Iron offers difficulties, on account of the dissolved gas causing foaming at the commencement of distillation, but with a current of 1000 amperes at 110 volts 400 grams of iron distilled in twenty minutes. The boiling point of uranium is higher than that of iron. The greatest difficulty was experienced with molybdenum and tungsten; the latter metal, with a current of 500 amperes at 110 volts, showed no signs of fusion in five minutes; even when the current was raised to 800 amperes only 25 grams could be distilled in twenty minutes.

Dr. G. H. Fowler desires it to be known that the Marseilles Exhibition of Oceanography and Sea Fisheries has not been "postponed," as stated in a circular issued by the British Commission of the Milan Exhibition. No postponement of the Marseilles Exhibition has been contemplated, though H.M. Treasury has refused financial support.

Messrs. Sampson Low, Ltd., have just published the eighth edition of Mr. W. T. Lynn's "Remarkable Eclipses" and the thirteenth edition of his "Remarkable Comets." Each book, though it contains only about fifty pages, gives an interesting and accurate statement of the main facts of the subject with which it deals.

The Country Press, Ball Street, Kensington, W., has issued a series of seven pictorial post-cards on which are shown in an effective manner forty-two species of British ferns. The idea is a good one, and should serve to direct the attention of young people to the beauties of this branch of plant life. Other natural objects are to be dealt with in a similar manner in future series of post-cards.

We have received a copy of the thirty-seventh annual report of the Wellington College Natural Science Society, that, namely, for 1905. It is quite clear that the society's activity has in no way diminished. The open Saturday meetings provide the boys of the school with excellent fortnightly lectures, the subjects of which are by no means

exclusively scientific. The meteorological record is as exhaustive as ever, and some reproduced photographs included in the report show that the photographic section is doing good work.

THE Cambridge University Press has published a third edition of "Hydrodynamics," by Prof. Horace Lamb, F.R.S. The second edition of this standard work was reviewed at length in NATURE of November 21, 1895 (vol. liii., p. 49). In the present issue no further change has been made in the general plan and arrangement of the first edition, but the work has been carefully revised, occasional passages have been re-written, and many interpolations and additions have been made, amounting in all to about one-fifth of the whole.

MR. S. HIRZEL, Leipzig, has commenced the publication of a new and elaborate work entitled "Handbuch der anorganischen Chemie," edited by Dr. R. Abegg, assisted by many leading workers in chemistry—particularly physical chemistry—in Germany and elsewhere. The second part of vol. ii. has recently been issued, the title being "Die Elemente der zweiten Gruppe des periodischen Systems." The first part of this volume has not yet appeared, but the first part of the third volume will be published in the spring of this year. We propose to notice the work when the volumes have been completed.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH :—

March 1. 6h. 14m. to 7h. 9m. Moon occults f Tauri (mag. 4·3).
,, 2. 6h. 41m. to 7h. 45m. Moon occults γ Tauri (mag. 3·9).
,, ,, 8h. 5m. Minimum of Algol (β Persei).
,, ,, 11h. 51m. to 12h. 40m. Moon occults θ^1 Tauri (mag. 3·9).
,, ,, 12h. 3m. to 12h. 31m. Moon occults θ^2 Tauri mag. 3·6).
,, 11. 16h. 11m. to 16h. 59m. Moon occults γ Virginis (mag. 3·0).
,, 12. 6h. 21m. to 8h. 31m. Transit of Jupiter's Satellite III. (Ganymede).
,, 14. 17h. 22m. to 18h. 23m. Moon occults γ Libræ (mag. 4·1).
,, 15. Venus. Illuminated portion of disc = 0·993; of Mars = 0·962.
,, 18. 5h. Mercury at greatest elongation (18° 31′ E.).
,, ,, 10h. 34m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
,, 19. 12h. 58m. Minimum of Algol (β Persei).
,, 21. 1h. Sun enters Aries. Spring commences.
,, 22. 9h. 47m. Minimum of Algol (β Persei).
,, 29. 10h. Jupiter in conjunction with Moon (Jupiter 4° 32′ N.).
,, ,, 20h. 56m. to 21h. 35m. Moon occults α Tauri (Aldebaran, mag. 1·1).

COMET 1906*a* (BROOKS).—A further extract from Herr M. Ebell's ephemeris for comet 1906*a*, as published in No. 4075 of the *Astronomische Nachrichten*, is given below :—

Ephemeris 12h. M.T. Berlin.

1906		α (true) h. m. s.		δ (true) ° ′		log r		log Δ		Brightness
Mar.	6 ...	5 46 7	...	+60 47	...	0·2329	...	0·0909	...	0 48
	8 ...	5 44 18	...	+58 26	...	0 2376	...	0·1072	...	0·43
	10 ...	5 43 6	...	+56 15	...	0 2423	...	0·1236	...	0·39
	12 ...	5 42 22	...	+54 13	...	c·2470	...	0·1398	...	0·36
	14 ...	5 42 2	...	+52 20	...	0·2517	...	0·1559	...	0·33
	16 ...	5 41 58	...	+50 35	...	0 2564	...	0·1718	...	0·30

This comet is now travelling nearly due south towards the constellation Auriga, and will apparently pass between Capella and β Aurigæ, nearer to the latter, on about March 21.

COMET 1905*c* (GIACOBINI).—Comet 1905*c* has now become so faint as to be beyond the reach of the naked-eye observer. On March 3 it will be only a little brighter than at the time of discovery, and will set just before 9 p.m., or about three hours after sunset, slightly to the south of west.

An extract from Herr A. Wedemeyer's daily ephemeris, as published in No. 4074 of the *Astronomische Nachrichten*, is given below :—

Ephemeris 12h. M.T. Berlin.

1906		α (true) h. m. s.		δ (true)		log r		log Δ		Brightness
Mar.	2 ...	1 53 41	...	−5 10	...	0 0384	...	0·1855	..	1·20
	4 ...	2 2 13	...	−4 0	...	0·0546	...	0·1983	...	1·05
	6 ...	2 10 16	...	−2 54	...	0·07c0	...	0 2109	...	0·92
	8 ...	2 17 55	...	−1 51	..	0·0846	..	0·2234	...	0·81
	10 ...	2 25 11	...	−0 52	..	0·0986	...	0·2358	...	0·72
	12 ...	2 32 6	...	+0 4	..	0·1120	...	0·2480	..	0·64
	14 ...	2 38 42	...	+0 58	...	0·1248	...	0·2600	...	0·57

From this it will be seen that the comet is now apparently traversing the constellation Cetus, and will be about 1° due north of the wonderful variable Mira on the evening of March 7.

A number of full notes of the observation of this comet at the Arcetri Observatory, between December 11 and 31, 1905, are given by Signor A. Abetti in No. 4073 of the *Astronomische Nachrichten*.

LIFE OF PIETRO TACCHINI.—We have received an interesting short biography of Prof. Tacchini, written in Italian by Signor L. Palazzo, who evidently knew the great Italian astronomer intimately, and appreciated his works. The brochure contains nine pages of text and a fine reproduction of Tacchini's portrait; it is published by the Typographical Society of Modena.

SUN-SPOT SPECTRA.—A valuable paper on the spectra of sun-spots is published in No. 1, vol. xxiii., of the *Astrophysical Journal* by Profs. Hale and Adams. The "widened lines" given in the table accompanying the paper number 345, and were measured on ten photographs —including three separate spots—taken with a grating spectrograph in connection with the Snow telescope of the Mount Wilson Solar Observatory.

The region measured was from λ 5000 to λ 5853, and, in a second table, the wave-lengths of a number of "bands" shown in the spot spectrum are also given.

The discussion of the results is extremely interesting, but is too lengthy to be even summarised here. It may be remarked, however, that the lines of titanium showed the greatest mean change of intensity, and that all the silicon lines in the region considered were much weakened.

Reproductions of some of the photographs obtained accompany the paper, and show the widened lines very clearly.

"THE HEAVENS AT A GLANCE."—This well known card calendar reaches its tenth year of issue with the present (1906) copy, which contains the usual data and notes. As in former years, we can only remark that it will be found to be a very handy and useful source of reference to everyone engaged in observational astronomy.

The calendar may be obtained from its author, Mr. A. Mee, Tremynfa, Llanishen (near Cardiff), for sevenpence, post free.

THE LANDSLIDE IN THE RHYMNEY VALLEY.

THE principal source of the Rhymney River is a copious spring in which the rain-water that has disappeared into numerous swallow-holes, and flowed for some distance underground in the Mountain Limestone, again rises to the surface near the edge of the Millstone Grit. From this point the incipient river flows in the direct line of dip of the strata, that is, in a south-south-easterly direction, across the outcrops of the Millstone Grit, the Lower Shale series, and the Pennant Sandstone series of the South Wales Coalfield. The length of its course on the Millstone Grit is nearly two miles, and on the Lower Shale series five miles.

The Brithidir—in some parts called the Tillery—seam of coal constitutes the dividing plane between the Pennant Sandstone and the Lower Shale series.

In a section taken at right angles across the valley at the point where the landslide—the subject of the present notes—is taking place, that is, about one and a half miles higher up the stream than the point at which the Brithidir seam dips under it, the bottom of the valley is 750 feet wide and 700 feet above sea-level; the outcrops of the Brithidir seam are 3000 feet apart and 1000 feet above sea-level, and the summits of the Pennant Sandstone are about one and a half miles apart and 1300 feet above sea-level. The average inclination from the outcrop of the seam to the bottom of the valley on each side is thus approximately 1 in 4.

Above the outcrops of the seam the ragged edges of the sandstone escarpments are seen projecting above the accumulations of débris which hide their bases; below the outcrops a superficial, grass-grown deposit, partly perhaps of Glacial origin, consisting of earth, clay, sand, and stones, probably not more than from 10 feet to 20 feet thick at any point, and possibly thinner in many places, lies upon and entirely conceals the shales. Part of this deposit, having a width of between 2000 feet and 3000 feet measured along the line of the valley, is known to have been slowly moving down the western slope ever since the Rhymney Railway was constructed across it, near the bottom of the valley, some fifty years ago. The excessive slowness of its general motion is shown by the following facts:—first, the railway, together with a stone bridge over it, has only been carried to a distance of from 6 feet to 10 feet eastwards from its original position during the whole of that long period of time; secondly, the arch of the bridge, which, although damaged and partially distorted, was prevented from being entirely broken up by placing heavy balks of timber between its side-walls under the level of the rails, was only removed, and replaced by a girder bridge, three years ago; lastly, the river, which flows at the foot of a steep bank, not far from the railway bridge, has retained its old channel, and has been able to carry away the débris from the foot of the moving bank sufficiently fast to prevent the latter from invading its bed.

Although the general movement of the ground is so slow and uniform that the roads and fences, and the vegetation which grows upon the surface, give no clue as to what is taking place over the greater part of the affected area, there are local indications here and there which show that a number of smaller and comparatively rapidly moving landslides have occurred within the larger area from time to time. One of these smaller landslides recently damaged the village of Troedyrhiwfuwch, situate near the upper end of the moving slope. This village consists of a public house, a school-room, and two rows of twenty or thirty houses, built upon the opposite sides of a road which runs parallel to the valley at a height of about 200 feet above the river. The pine-ends of many of the houses, in the row nearest the centre of the valley, appear to have lately undergone substantial repairs, and the public house has been entirely re-built, with its foundations, it is said, now resting on the solid rock. The gardens of the houses nearest the northern end of the row now under consideration, together with the division walls between them and the outhouses contained in them, have been ruined beyond repair, and part of the ground on which the gardens were formed has been broken and piled up behind the houses like the front of a wave advancing down the slope, and appears to be still moving.

In this part of the coalfield, as well as over practically the whole of Monmouthshire and part of East Glamorganshire, the strata immediately underlying the Pennant Sandstones consist of a succession of red and blue shales and marls of greater or less thickness. In the New Tredegar pits, which are not far from this locality, the red and blue ground has a thickness of more than 300 feet. This is, therefore, the kind of ground upon which the landslide is taking place. But as most strata of this kind disintegrate and soften when exposed to air and moisture, it is not improbable that this property of theirs accounts, to some extent at least, for the gradual movement of the deposits lying upon them on the west side of the valley, and that it may be likewise responsible for the more sudden landslide that took place a year or two ago on the opposite side of the valley, which seriously damaged both the Brecon and Merthyr Railway and one of the Powell Duffryn collieries which lay in its path.

My thanks for information concerning the Rhymney Railway and the bridge over it are due to Mr. Cornelius Lundie, formerly general manager, and now consulting director, to the railway company, who has known, and has had occasion to observe, the movements taking place in this locality for the last forty-five years, and is therefore thoroughly conversant with the subject.

W. GALLOWAY.

THE LAW RELATING TO UNDERGROUND WATERS.

IN one of the State papers recently issued by the department of the United States Geological Survey there is a report by Mr. D. W. Johnson dealing with the rights of landowners and others to underground waters, for the purpose of giving the owners of such waters some idea of their rights and obligations.[1]

The report is not intended to be a legal treatise, but as a practical guide for the officers of the hydrological department, showing the relation of the law to problems which are of a more or less hydro-geological character.

The law relating to underground waters in the United States is practically the same as in this country, and the decisions given in the courts there are founded on British precedents modified in some cases by the different circumstances of the two countries.

Underground water is held to comprise all water which for the time being is below the surface of the ground, whether by penetration of the rainfall or soakage from rivers and lakes, and which is dissipated throughout the mass of porous soil or rock, except in cases where the underground water can be traced as moving in a well ascertained and definite course that can be located.

The fundamental principle upon which the laws regulating the use of underground water is formed is this:—That such percolating subterranean waters are a part of the land itself. The land belongs to the owner, whether it be rock, porous ground, earthy matter, or part soil and part water, the water being as much his property as rock, ores, or minerals. Consequently, he may take and use such waters as he pleases, even though such use may damage his neighbour by removing or diminishing water from adjacent wells or springs, by causing subsidence to land or buildings by abstraction of the water, or by rendering the water useless by pollution from sewage or refuse from factories or mines, &c.

This principle has been admitted in the decisions given by the courts owing to the difficulty of proving how much of such water was within the limits of any given area, how much comes from adjacent land, or how much passes from one man's land to that of his neighbour, and the impossibility of predicting what result may ensue from interference with what has been regarded as an unknown quantity. There are, of course, local circumstances or conditions which modify this general statement, but, broadly, this is how the law stands at present.

In the United States, however, conditions have for some time past been undergoing an alteration, and the investigations and observations undertaken by the hydrological department of the Government have been throwing considerable light on the action of underground waters. In many cases the original lack of knowledge which was the reason for the ruling of the law as it now stands has already disappeared.

We recently gave a short illustrated description of the methods adopted by surveyors of the department for measuring and defining the rate and direction of the flow, and more particularly for showing the effect of percolation of deleterious matter from factories, oil wells, &c., on the underground supply of drinking water (NATURE, December 21, 1905).

[1] "Relation of the Law to Underground Waters." By D. W. Johnson. Water Supply and Irrigation Papers, No. 122. (Washington: Government Publishing Office, 1905.)

The state of knowledge regarding the properties of underground water may be said now to have become in advance of the ruling of the courts on some of the questions involved. The earlier legal decisions were made when little or nothing was known regarding the action of the water beneath the surface. Since then the progress of hydro-geological science has established as facts many things regarding underground waters previously unknown or only speculative, and the knowledge of the working of underground waters remains much less in the realms of the "secret, occult, and concealed." It has now become possible to define certain rights in these waters and to protect these rights equally as well as those in surface waters.

A case recently dealt with in one of the American State courts directs attention to the importance of emphasising the influence that the ever-increasing knowledge concerning underground waters may have in governing legal decisions. In an action brought in the State of Pennsylvania regarding the pollution of underground water, the judge remarked:—Geology has become a progressive and in many respects a practical science. More deep wells have been sunk in one State of America than had previously been dug in the entire earth in all time; and that which was formerly held to be unknown and merely speculative regarding the properties of underground water has been by experience reduced almost to a certainty. If it can be shown that the work done by the owner of the land would cause the inflow of salt water or oil to mingle with fresh water, and the means of preventing the mixing are available at a reasonable expense, then clearly it is a violation of the spirit of the law not to recognise the change, and to apply the settled principles of right to the altered conditions of fact.

In another case tried in California it was held that the usual rule of common law on the subject of percolation was not to be held as applying to an arid district that depended entirely for its cultivation on water derived from underground sources, and where the conditions were totally different from those existing in the locality where the rule in question was first established, and therefore an owner has no right to injure his neighbour's land by any unreasonable diversion of underground water by transferring the same for gain to another district.

PHYSICAL RESEARCH IN AMERICA.

TWO volumes, representing the first instalments of what is promised to be an annual publication, have been received from the physical laboratories of Harvard University.[1] Each contains fourteen papers contributed by the professors, staff, and students. In the preface the director, Prof. Trowbridge, acknowledges the great stimulus received by the establishment of the Thomas Jefferson Coolidge research fund, which has provided the laboratory with what the volumes show to be a very fine equipment, and has greatly increased the enthusiasm for physical research.

Most of the papers included are reprints from the *Proceedings of the American Academy* and the *Astrophysical Journal*. It is hardly possible to speak too highly of the handsome treatment they have received at the hands of the printer and binder, and especially of the manner in which the numerous plates have been reproduced. The range of subjects treated is a very wide one, and in a review of this kind it is not possible to deal with each paper individually.

In the first volume Prof. Trowbridge contributes an interesting paper on the spectra of gases and metals at high temperatures. He attempts to apply electrical stimulus of known amount to the gas in a vacuum tube by discharging through it a condenser of known capacity charged to a high potential by his powerful accumulator battery, by which he can obtain pressures up to 40,000 volts. He contrasts the relative intensities of the lines in the spectra thus obtained with the results got by other methods. When theorising on the relative volatility of metals it is desirable, however, to adopt more accurate data than some of those used in this paper, where "soft-iron" is said to melt "not far from 1100°," and aluminium "between 700° and 800°," instead of 657°.

Spectroscopy is evidently a favourite study in the laboratory, since five papers in each of the two volumes are devoted to it. Mr. Lyman gives an explanation of the "ghosts" and "false spectra" sometimes met with when using gratings, particularly in the extreme ultra-violet, and shows in a number of cases the relation between the wave-lengths of the various false lines and those of the parent lines to which they are due.

In another paper he discusses the various kinds of prolongations of spectral lines met with when using gratings, and shows them to be due to a cause quite different from Sir Norman Lockyer's "long and short lines."

Another interesting paper is by Mr. Morse on the spectra from the break in the Wehnelt interrupter, which appears to give spectra of a special character not classifiable under the division of "flame," "arc," "spark," or "enhanced spark."

Mr. B. O. Pierce contributes, in continuation of an earlier research, papers on thermal conductivity of rocks, one of which must have involved a long period of painstaking work. The apparatus employed was on a scale only possible where very considerable funds were available.

Prof. Hall has a paper on a theory of thermoelectric action, and, along with three other workers, one on thermal and electrical effects in "soft iron."

In several instances, work commenced in the laboratory appears to have been dropped on the publication of some paper slightly overlapping the research contemplated. It is a pity, for example, that the fine resistance bridge for platinum thermometry, described by Mr. Edwards, should not be used to solve some of the problems for which it is suited, and that the construction of a gas thermometer should not be proceeded with because of the publication during the past few years of several researches on gas thermometry.

Though none of the papers appear to be of epoch-making importance, the volumes show how a well equipped laboratory may contribute substantially to the advancement of knowledge. It would be interesting to see what effect the endowment of a representative physical laboratory in this country, with funds for research purposes, would have on the character of the work done, especially if at the same time it were possible to arrange that members of the teaching staff should have a more reasonable proportion of their time to devote to research work.

J. A. H.

[1] "Contributions from the Jefferson Physical Laboratory of Harvard University." (Cambridge, Mass., vol. i., 1903; vol. ii., 1904.)

FIREBALL OF JANUARY 27, 1906.

A MAGNIFICENT fireball was seen by many persons in the north of England on the evening of January 27 at 8h. 33m. Descriptions of its appearance have been received from Hull, Bramley, Bradford, Patrington, and other places in Yorkshire, from Sleaford and Billingborough in Lincolnshire, from Cheadle, Staffordshire, &c.

Mr. H. Beckwith, at Hull, observed the meteor travelling horizontally between the "square" of Ursa Major and the Belt of Orion, while at Cheadle, Miss Blagg noted the path as just above ζ Leonis. Mr. R. Felton, at Patrington, estimated the brightness of the object as quite equal to that of the full moon. It left a trail visible for some time afterwards; one observer says it remained for five minutes, two others estimate the duration as eight minutes, while at Billingborough a spectator watched it for more than ten minutes.

The meteor gave a very brilliant flash near its end point, and the suddenness of its apparition startled many people. Several of the observers were enabled to give the position of its flight with fair accuracy from the luminous trail it left behind.

The radiant point appears to have been near θ Boötis, or in $214°+53°$, and the height of the meteor was from about 59 to 45 miles over the North Sea immediately east of the Lincolnshire coast. The disappearance occurred at a point over "the Wash," about 6 miles S.S.E. from Wainfleet. The length of observed path was approximately

42 miles, and probable velocity of the object 24 miles per second.

The radiant point in the right hand of Boötes is very little known as a centre of meteoric divergence in the month of January. The only shower conformable with it was observed at Bristol in 1887–9 January 25–29, 213°+52°.

In recent years fireballs have been very numerous in this month, and especially at the epochs about January 9 to 13 and 24 to 29. They appear, however, to have belonged to a great many different systems, and have not supplied evidence of any rich individual display of bright meteors at this time of the year.

W. F. Denning.

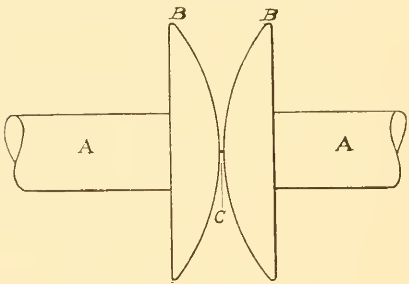
METHOD OF PRODUCING WAVES OF FREQUENCY INTERMEDIATE BETWEEN HEAT WAVES AND HERTZIAN WAVES.

THERE is at present a considerable gap of unexplored wave-lengths intermediate between those of Hertzian waves and what is commonly known as heat. The shortest Hertzian waves which have heretofore been produced are of the order of one millimetre length.

Some years ago the writer discovered a method of producing the heretofore unknown waves above referred to.

It is based on the phenomenon discovered by the writer and published by him in a paper on insulation and conduction read before the American Institute of Electrical Engineers in 1894.

In the accompanying figure, AA are copper rods, BB are plano-convex lenses. The distance between the surfaces of



the lenses depends upon the wave-length which it is desired to produce.

If BB were metallic terminals, the discharge passing at C would have a long wave-length on account of the capacity of BB. It is impossible to make metallic terminals small enough to get very short wave-lengths. But, in the apparatus shown in the sketch, if AA are connected to the terminals of a high-voltage machine sparks will be found to pass at C, and the oscillating conductor is merely the small column of incandescent gas, C.

If the distance between BB is very short, the wave-length will also be very short.

Waves may be produced in this method having a wave-length certainly not longer than a few ten-thousandths of an inch, and there would appear to be no necessary limit to the frequency. It sometimes happens that the discharge tends to pass at a point outside the axis, and hence to give a longer wave-length than desired, but this can be avoided by properly proportioning the curvature of the lenses and the diameter of the rods AA.

Inert gases of the helium type seem to give the best results, but very good results are obtained by using quartz lenses in air, the use of quartz having been suggested to me by Prof. Elihu Thomson. Quartz does not seem to become conducting on being heated by the passage of the discharge to anything like the same extent as glass, and hence the wave-length remains more constant.

Owing to pressure of other work, the writer has been unable to continue these experiments, but the apparatus would seem to be of interest as offering a means of obtaining waves of any desired high frequency.

Reginald A. Fessenden.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The statement of the income and expenditure of the Common University Fund for 1905, published in last week's *Gazette*, shows that the income was 6806*l*. 9*s*. 8*d*., to which the colleges contributed 6197*l*. 19*s*. 4*d*. under the statute concerning college contributions for university purposes, and the Royal Geographical Society 400*l*. towards the support of the department of geography. The total expenditure was 6260*l*. 14*s*. 11*d*., of which sum 3662*l*. 19*s*. 5*d*. was devoted to scientific purposes, partly in the payment of the salaries of university readers and professors, and partly in assisting various laboratories and providing demonstrators and assistants.

At a meeting of the Junior Scientific Club, held at the Museum on February 23, Mr. M. H. Godby (Christ Church) read a paper on "The Place of Natural Science in Education."

Cambridge.—The Vice-Chancellor has been authorised to convey to Lord Rayleigh the grateful thanks of the University for his magnificent gift of 7733*l*. 12*s*. 8*d*., being the amount of the Nobel prize awarded to him in 1904. Lord Rayleigh desires that 5000*l*. of this should be employed in erecting a new building in connection with the Cavendish Laboratory, and that the remainder should be devoted to the purchase of scientific books and periodicals for the University Library.

Sir George Darwin, K.C.B., Plumian professor of astronomy, will represent the University at the celebration of the 200th anniversary of the birth of Benjamin Franklin at Philadelphia in April.

The Special Board of Biology and Geology recommended that the agreement between the University and Dr. Dohrn, director of the Zoological Station at Naples, be renewed for a further period of five years by the payment to him of 100*l*. per annum out of the Worts travelling bachelors fund.

The General Board of Studies has nominated the following gentlemen as members of the Board of Electors to the professorships named below:—Dr. B. C. A. Windle, to the professorship of human anatomy; Prof. F. W. Oliver, to the professorship of botany; Lord Walsingham, to the professorship of zoology and comparative anatomy; Mr. J. Hutchinson, to the professorship of surgery; the Earl of Carrington, G.C.M.G., to the professorship of agriculture.

The following have been nominated examiners by the General Board of Studies for the special examination in agricultural science and for the diploma in agriculture:—Mr. J. B. Peace, Mr. H. Woods, Mr. T. B. Wood, Mr. R. H. Biffen, Prof. Middleton, Dr. Shore, Mr. T. A. Dickson, and Mr. A. E. Shipley.

At Gonville and Caius College the triennial Thruston prize of 54*l*., open to a member of the college of not more than fifteen years' standing who has published in the course of the preceding three years the best original investigation in physiology, pathology, or practical medicine, has been awarded to Mr. W. S. Perrin, research student of the college. Mr. Perrin is an expert on protozoology, and has published papers on a so-called trypanosome in the oyster and on *Pleistophora periplanetae*.

Lord Rayleigh has promised to lay the foundation-stone of a new science school at Dulwich College on Saturday, March 3.

To the new buildings of the Sorbonne it has been decided to add a new university chemical laboratory, the Institut de Chimie, on a site between la rue Saint-Jacques and la rue d'Ulm, that is, in the neighbourhood of the Sorbonne.

Prof. R. J. Harvey Gibson writes from the Hartley Botanical Laboratories, University of Liverpool, to point

out that the proposed grant referred to in a note last week (p. 406) is to be made to the botanical laboratories to meet the expenses of investigations in applied botany which the agricultural committee of the County Council desires the botanical department of the University to carry out. He adds:—"There is no department of economic botany in the University, nor has any fund been collected for the establishment of such a department, so that the cost of such a school is not in any sense 'guaranteed.'"

THE Treasury has appointed a permanent committee to advise the department as to the distribution of the grant-in-aid of colleges furnishing education of a university standard. The constitution of the committee is as follows:—The Rev. H. G. Woods, chairman, Sir Francis Mowatt, G.C.B., Sir William J. Collins, M.P., Prof. Henry Jackson, and Prof. W. S. McCormick. Mr. R. G. Hawtrey, of the Treasury, will act as secretary. Dr. H. G. Woods, the chairman of the committee, was in 1901 a Treasury Commissioner for the inspection of university colleges. It will be noticed that the interests of science are not represented upon the committee.

THE academic congress, which recently met in St. Petersburg to consider a number of questions relating to Russian higher education, arrived at the following conclusions:—The Imperial Russian universities ought to be State institutions, the duty of which should be to foster the natural sciences; they should be autonomous institutions, responsible only to the Minister of Education; they should, further, be open to persons of both sexes alike, irrespective of nationality and religious creeds; the university diplomas should give no privileges in the entrance to the professions, &c.; the State examinations should be maintained, and those persons desirous of exercising the right of putting their knowledge to professional uses should be required to submit themselves to the corresponding State examinations; the degree of "Master" should be abolished, and those now holding it should receive the "Doctor's" degree.

THE Charity Commission has forwarded to the Education Committee of the London County Council a draft scheme which provides that the City Polytechnic, which hitherto has comprised the Birkbeck College, City of London College, and Northampton Institute, shall cease to exist. It is proposed that the Birkbeck College and the City of London College shall constitute separate foundations, while the Northampton Institute shall constitute a separate charity. The whole of the endowments of the Birkbeck College and the City of London College are determined as educational endowments, and will therefore henceforth be under the control of the Board of Education and not of the Charity Commissioners, but the Northampton Institute, as a charity, will presumably continue to be supervised by the Charity Commission, and power is reserved for the establishment of further schemes in respect of the two colleges by the Board of Education and in respect of the Northampton Institute by the Charity Commission. Subject to these provisions, the several institutions are to be managed in accordance with their existing schemes and by their present governing bodies.

IN the House of Commons on Monday Mr. Austen Chamberlain asked the Chancellor of the Exchequer whether he had undertaken to include in the Estimates for 1906–7 a sum of 20,000*l.* for the building fund of the University College of North Wales, to which fund 61,000*l.* had been subscribed locally; if so, whether any conditions had been attached to the proposed grant; and whether he would make provision in the Estimates for similar grants to the universities and university colleges of England in the same proportion to the local subscriptions. In reply, the Chancellor of the Exchequer said:—"I have undertaken to ask Parliament to make a grant of 20,000*l.* to the building fund of the college when the money is actually required for the scheme, and subject to the condition that a similar sum has first been spent upon it from other sources. No part of this grant will have to be provided in the Estimates for 1906–7. Similar grants have already been made to the two other Welsh colleges of like character. No such grants have in the past been made to university colleges in England, and, as the annual grants to these institutions were largely increased—as I think most properly increased—by the right hon. gentleman when he was Chancellor of the Exchequer, I am not, as at present advised, prepared to recommend a change of policy."

THE annual meeting of University College was held on February 21. Lord Reay, who presided, referred to the incorporation of the college in the University of London, and said its object is to secure the good of university education in London as a whole. Speaking of the proposed college of technology, Lord Reay said he is convinced that increased facilities for higher technological work are required in London, but unless all such higher technological work is in the hands of the same authority there will be the same risk of overlapping, duplication, possibly of triplication, that there has been in the past. Now is the great opportunity for giving to the University its due responsibility, and from what the University has done in the last five years, said Lord Reay, it will not fail to bear that responsibility. If brought within the University the new college of technology would be managed by a college committee much as University College will be managed. Such college committee would be subject to the general direction on matters of university policy of the Senate, but in all other matters it would be practically self-governing. It would be possible to start the new college at once within the University, and while starting it with a committee under the Senate there would be time to consider what modifications in the general constitution of the University would be made necessary.

IN the absence of Mr. Chamberlain, the Chancellor, Alderman C. G. Beale, the Vice-Chancellor, presided at the sixth annual meeting of the Birmingham University Court of Governors on February 21. From the financial statement it was seen that the income for the year had been nearly 43,000*l.*; two new chairs had been inaugurated during the last twelve months, one for electrical engineering and the other for civil engineering. The engineering department as a whole had moved into its new quarters at Bournbrook; although they were expecting the early completion of this section, they were also looking forward to the beginning of another by reason of the generous donation of 50,000*l.* in November of last year; the exact form of the extension was not yet fully decided, but plans for the erection of new chemical and physical departments were being prepared. Remarking upon the difficulty of determining how far a certain sum of money would go in providing such accommodation, Alderman Beale observed that whatever was done should be done on a sufficiently large scale to be permanent; they had sufficient experience to show that the large scale would be the best in the long run. The erection of the Harding Memorial Library, the outcome of the generous gift of 10,000*l.* from the family of the late Mr. Charles Harding, was contemplated. The University had broken new ground, as stated in the principal's report, by the appointment of Mr. W. E. Collinge as special lecturer in economic biology.

LORD HALSBURY delivered an address at the annual prize distribution of the City and Guilds of London Institute on February 16. He said that the old apprenticeship system was a good rough-and-ready way of teaching young people what they wished to practise later in life. What has been attempted more recently, however, is to teach, not only how to do things, but the principles underlying their action. As the result of the developments of modern life, the whole world has become the market for competition. In Germany, France, Switzerland, and other Continental nations it has long been recognised that the old ways in trade and commerce will not do, and the people there have been preparing themselves by technical education, and in other respects, not only to hold their own, but to forge ahead in the industrial race. It is all very well for us to assume an indifferent air, and say that we have been getting on very well. Unfortunately, the facts seem to tell a different story. For the maintenance of our commerce we must use the means that other countries have used with such successful results. As a judge, Lord Halsbury was often struck with the large number of patent cases that

came before him in which the patents had been taken out in Germany and brought over here to be developed and worked at a profit. Why was this? While Germany has founded numerous places for chemical experiment and research, nothing of the kind is provided here, except at such colleges and schools as those belonging to the City and Guilds of London Institute. It is a matter of national concern that whatever is possible should be done to give a stimulus to the scientific and industrial activity of the country.

SOCIETIES AND ACADEMIES.

London.

Society of Chemical Industry (London Section), February 5.—Mr. R. J. Friswell in the chair.—Carburetted water gas in the Bunsen burner: M. **Chikashigé.** Carburetted water gas is now prepared in the Kyoto University by injecting heavy petroleum oil with steam into a water-gas generator filled with ignited coke. The gas produced is passed through a superheater loosely packed with fire-bricks, and then through a scrubber, after which treatment it enters the gas holders. The mean composition of the gas differs little from that of coal gas, and the products of combustion closely resemble those of coal gas. The carburetted gas has no effect on the ordinary laboratory vessels, and the products of combustion, unlike those of plain water gas, are not more injurious in insufficiently ventilated laboratories than those of coal gas.—The loss of nitre in the chamber process, part ii.: J. K. H. **Inglis.** The loss of nitre, which usually amounts to about 3 per cent. of the sulphur burnt, can best be traced by complete analyses of the flue gases. The analysis cannot be carried out by means of aqueous absorbents owing to the formation of complicated bodies by the interaction of nitrous acid and sulphur dioxide. But the analysis may be conveniently made by the fractional distillation of the gases, first at the temperature of liquid air and subsequently at higher temperatures. The results showed that only about 4 per cent. of the lost nitre was lost as nitrous oxide and 43 per cent. as nitrogen peroxide. In the first experiments the temperature of liquid air was insufficient to effect the separation of nitric oxide from the flue gases owing to the vapour pressure of nitric oxide. Some further experiments were therefore made at a lower temperature obtained by making liquid air boil under diminished pressure. The amount of nitrogen oxides found was no greater than in the earlier experiments, and this might therefore mean that nitric oxide is not present in the flue gases.—The removal of nitrous acid from concentrated nitric and sulphuric acid: O. **Silberrad** and B. J. **Smart.** The experiments were made to determine to what extent the reaction between nitrous acid and amines or amides occurs in concentrated acids. Nitric acid containing a small percentage of nitrous acid was taken either alone or in admixture with sulphuric acid. The addition of hydrazine occasions an explosion, and with this exception substances such as urea, lead peroxide, oxamide, methylamine nitrate, and amido guanidine are very inert towards nitrous acid in presence of concentrated nitric acid, although they react readily in dilute solution. The observation of Franchimont that urea nitrate decomposes with evolution of carbon dioxide and nitrous oxide was confirmed.

Zoological Society, February 6.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Mounted cubs of the timber-wolf (*Canis occidentalis*), obtained in the province of Keewatin, Canada: F. **Gillett.**—Restored models of the skulls and mandibles of Mœritherium and Palæomastodon: Dr. C. W. **Andrews.** The models were prepared by Mr. F. O. Barlow from the original specimens collected from the Upper and Middle Eocene beds of the Fayûm, Egypt, and now preserved in the British Museum and the Geological Museum, Cairo.—Lantern-slides of sections of skin from the palmar and plantar surfaces of twenty-four species of mammals, and the plantar surfaces of seven species of birds: Dr. W. **Kidd.** The functions of the papillary ridges and the papillary layer of the corium in connection with the sense of touch were alluded to.—Histology and physiology of the placenta in the Ungulata: Dr. J. W. **Jenkinson.** A recent examination of the histological structure of the placenta in the sheep and cow has shown (1) that in the formation of the accessory cotyledons of the cow the epithelium lining the cotyledonary crypts arises by simple modification of the uterine epithelium; (2) that in the fully formed principal cotyledons of both cow and sheep there is complete continuity of the intra- with the extra-cotyledonary uterine epithelium; (3) that the greenish-brown pigment so abundantly present in the trophoblast-cells is a derivative of the hæmoglobin of the maternal corpuscles which those cells have ingested. The pigment—which contains no iron—is of two kinds, one of which has a definite absorption spectrum resembling closely that of oxyhæmoglobin. In acid solution the spectrum approaches that of acid hæmatoporphyrin.—A living specimen of a dwarf species of cavy, probably the salt-marsh cavy (*Dolichotis salinicola*): Sir Edmund **Loder,** Bart. Owing to Burmeister (the original describer of the animal) being under the erroneous impression that he had founded the species on young specimens and the fact that two distinct species occurred in the same district, some considerable confusion had been caused as to the status of the different forms of Dolichotis. The author pointed out that the common Patagonian cavy (*D. patagonicus*) differed from the dwarf *D. salinicola* and the larger *D. magellanicus centricola* (the two species found together) in having a broad dark band above the white rump-patch.—A description of Trichorhiza, a new hydroid genus: E. S. **Russell.**—Description of the new genus Melissomorpha, formed for the reception of a horse-fly of the Pangoninæ division of the family Tabanidæ, discovered by Colonel C. T. Bingham in Sikkim: Gertrude **Ricardo.** The insect closely mimicked the Indian bee *Apis dorsata*, L., having the flattened wide tibiæ characteristic of the hive-bee, the general resemblance between the bee and the fly being very striking.—Mammals collected at Kuruman and Molopo in Bechuanaland by Messrs. R. B. Woosnam and R. E. Dent: H. **Schwann.** The specimens, numbering about 120, and belonging to 26 species, were of great interest as being topotypes of several species described by Sir Andrew Smith in his expedition to Kuruman and the interior of South Africa.—Description of a new species of ratel (Mellivora) from Central Africa, also notice of the occurrence of a new subspecies of chevrotain (Dorcatherium) in that district: R. **Lydekker.** The author proposed to divide the genus into three geographical races, viz. the typical form from the Gambia, Bates's chevrotain from the Cameroons, and the present—Cotton's chevrotain—from the Ituri Forest.—The articulation of the vertebrate jaw: H. G. F. **Spurrell.** The object of this paper is to direct attention to the existence of two types of mouth in vertebrates. In one type the articulation is in the plane in which the teeth meet; in the other type it is not in the plane in which the teeth meet, but in mammals above, in reptiles below that level. This alteration in level is attained in mammals by an ascending ramus of the jaw, in reptiles by a long quadrate bone.

Entomological Society, February 7.—Mr. F. Merrifield, president, in the chair.—*Exhibitions.*—Specimen of *Lathrobium laevipenne*, Heer, a beetle new to the British list, taken in a sandpit near Oxted, Surrey, in August, 1905: W. E. **Sharp.**—Specimens of South African butterflies belonging to the Nymphalinæ, Acræinæ, Danainæ, and Papilioninæ: Dr. F. A. **Dixey.** Attention was directed to the significance of the fact that scents of an agreeable nature (as in Pierinæ generally, *Mycalesis safitza*, &c.) were as a rule confined to the male sex, while those of a disagreeable or disgusting character (as in Acræinæ and many Papilios) were often common to both sexes.—Four species of Acræa taken in South Africa during the visit of the British Association: Dr. G. B. **Longstaff.** The species were (1) *A. anemosa*, Hew., from the Victoria Falls, and Mochudi, in Bechuanaland; (2) *A. alboradiata*, Auriv., previously known to Mr. Roland Trimen by two females only, and considered by him as a variety of *anemosa*; (3) *A. atolmis*, Westw., to which Westwood gave the names of *atolmis* and *acontias*, although there seems no doubt they are one species; (4) *A. atergatis*, Westw., the two types of which are in the Hope collection at Oxford.—Two Diptera, which had been observed follow-

ing the bee, *Andrena labialis*, Kirb., by Mr. A. H. Hamm, identified by Mr. G. H. Verrall as a species of Chortophila: Prof. E. B. **Poulton.** Prof. Poulton stated that new and interesting light had been thrown on the observation by Colonel Yerbury, who pointed out that both flies were males. At first sight it seemed astonishing that the bees should be pursued by the males of inquiline flies, but he suggested that the males in this way find their way to the burrows, where they meet the females, which have also reached them in the same manner, or where, more probably, they lie in wait for the freshly emerging females.—Collection of Rhopalocera made in Spain during July and August, 1905: W. G. **Sheldon.** There were also shown for comparison typical European specimens; an aberration of *A. aglaia*, with the black blotches on the superiors enlarged and banded, and with dark suffused ground colour on all wings; and an interesting series of *L. corydon* and var. *hispana*, with forms approaching var. *polonus*, from Aragon, and intermediates between all these forms, and also British, French, and Swiss typical specimens for comparison.—*Papers*.—(1) Some rest attitudes of butterflies; (2) some bionomic points in certain South African Lamellicorns: Dr. G. B. **Longstaff.**—Some new or hitherto unfigured species of South African butterflies: Roland **Trimen.**—Some observations on the reproduction of Hemiptera-Cryptocera by Claydon Hewett: Commander J. J. **Walker.**

Chemical Society, February 15.—Prof. R. Meldola, F.R.S., president, in the chair.—Cuprous formate: A. **Angel.** This salt was prepared by dissolving cuprous oxide in an aqueous ammoniacal solution of ammonium formate under petroleum, diluting with alcohol, acidifying with formic acid, and washing the deposited crystals with ethyl formate. Water immediately hydrolyses it to cuprous oxide and formic acid, and dilute sulphuric acid at once produces a precipitate of metallic copper.—The solubility of triphenylmethane in organic liquids, with which it forms crystalline compounds: H. **Hartley** and N. G. **Thomas.** The results of these experiments confirm the existence of a metastable region in which supersaturated solutions cannot crystallise spontaneously.—The spontaneous crystallisation of supersaturated solutions: H. **Hartley.** It was shown how the difference between metastable and labile solutions might be explained from the kinetic standpoint as a result of the increased solubility of the small crystals which must be first formed in a spontaneous crystallisation.—Preparation and properties of some new tropeines: H. A. D. **Jowett** and A. C. O. **Hann.** The tropeines of methylparaconic, terebic, glycollic, protocatechuic, and phthalidecarboxylic acids were prepared. The results of physiological experiments with these confirm Ladenburg's view that for mydriatic action to exist in a tropeine the acyl group should contain a benzene nucleus and an aliphatic hydroxyl in the side-chain containing the carboxyl group.—Studies in asymmetric synthesis, iv., the application of Grignard's reaction for asymmetric syntheses: A. **McKenzie.** The author has studied the action of magnesium propyl iodide, magnesium *iso*butyl iodide, and magnesium α-naphthyl bromide respectively on *l*-menthyl benzoylformate, and effected in each case an asymmetric synthesis of a substituted *l*-glycollic acid.—*o*-Cyanobenzenesulphonic acid and its derivatives: A. J. **Walker** and E. **Smith.** The authors described a modification of Jesurun's method for the preparation of *o*-cyanobenzenesulphonic chloride, and referred to various substances obtained from this by reduction and hydrolysis.—The condensation of dimethyldihydroresorcinol and of chloroketodimethyltetrahydrobenzene with primary amines, part ii., diamines, *m*- and *p*-phenylenediamines: P. **Haas.**—A modification of the volumetric estimation of free acid in the presence of iron salts: C. Chester **Ahlum.** The iron is precipitated by means of sodium dihydrogen phosphate, and the filtrate titrated with standard sodium hydroxide. In the reaction of the ferric salt with the phosphate, a definite quantity of acid, directly proportional to the amount of "ferric" iron present, is liberated, and is corrected for by estimating the "ferric" iron present before titrating. The method is applicable to natural waters containing iron salts and free acid.—The theory of alkaline development, with notes on the affinities of certain reducing agents: S. E. **Sheppard.**—Resolution of 2:3-dihydro-3-methylindene-2-carboxylic acid into its optically active isomerides: A. **Neville.** The acid forms with *l*-menthylamine a well defined crystalline salt, which on crystallisation from ethyl acetate gives, after a few crystallisations, the pure salts of the *d*-acid and *l*-base.

PARIS.

Academy of Sciences, February 19.—M. H. Poincaré in the chair.—The simultaneous determination of two points by means of graphical construction on the large scale: M. **Hatt.**—The boiling and distillation of nickel, iron, manganese, molybdenum, tungsten, and uranium: Henri **Moissan** (see p. 424).—The function of organic matter in nitrification: A. **Müntz** and E. **Laine.** The experiments of Winogradsky and Omeliansky have given rise to the idea that the presence of humic material is not only unnecessary, but even harmful to the process of nitrification. The present researches deal specially with the *rôle* of humus in the nitrifying process, and it was found that organic material in this form does not hinder the process, and may be favourable. Abundance of humus is not an indispensable condition for nitrification, but its presence is favourable to the multiplication of the organisms, and the nitrification ultimately becomes more rapid.—The reproduction of architectural monuments from their photographs, practised especially in Germany: M. **Laussedat.**—Synthesis of tertiary alcohols derived from paramethylcyclohexane: Paul **Sabatier** and A. **Mailhe.** Methylcyclohexanone (1:4) is readily obtained from paracresol by reduction in presence of reduced nickel. It reacts energetically with organomagnesium halogen compounds, and the product of the reaction treated with water gives tertiary alcohol. The alcohols arising from the action of the methyl, ethyl, propyl, isopropyl, isobutyl, isoamyl, and octyl magnesium iodides (or bromides) are described in detail, and also the substituted ethylenes arising from their dehydration. The reaction with phenyl-magnesium bromide and benzyl-magnesium chloride is also given. The optical constants were determined, and found to correspond very closely with the molecular refractive powers calculated from the coefficients of Conrady and Brühl, thus furnishing a further proof that the hexamethylene ring introduces no abnormality into the refractive constant.—The dangers of the ingestion of dead tubercle bacilli into tuberculous and healthy animals: A. **Calmette** and M. **Breton.** In the experiments described the tuberculous bacilli were sterilised by heating to 100° C. Tuberculous guinea-pigs had their death hastened by the repeated injection or ingestion of sterilised tubercle bacilli, the general effect being similar to that produced by repeated injection of tuberculin. In healthy animals the results are injurious, sometimes producing disorders resembling those produced by tuberculin. One practical conclusion to be drawn from this work is that milk from tuberculous cows, even after sterilisation by heat, is not a safe food, especially if the person taking such milk is already tuberculous.—The photographic study of the duration of discharge in a Crookes' tube: André **Broca** and M. **Turchini.** The photographs of the spark were taken from a rotating mirror, the velocity being adjusted so that a time of 0·001 second corresponded to 63 mm. on the plate. The photographs showed a sudden commencement of the discharge lasting 0·00025 second, followed by a weakening terminating asymptotically at the end of about 0·0008 second. With a soft tube the same form of discharge was observed, but the time throughout was greater. The authors regard this method as giving an upper limit for the time of discharge.—A method for measuring the total quantity of X-rays emitted in a given time: M. **Gaiffe.**—The radio-activity of springs of potable water: F. **Diénert** and E. **Bouquet.** Measurements are given of the radio-activity of the water from the Group de Nouvet, Erigny, Rivière, and Breuil springs.—The condensation of the acetylenic nitriles with phenols. A general method of synthesis of β-substituted acrylic β-oxyphenol nitriles: Ch. **Moureu** and I. **Lazennec.** It has been found that the condensation between alcohols and nitriles of the type R—C≡C—CN also takes place when phenols are substituted for the alcohols. Details are given of seven compounds formed in this way.—Researches in the pyrane series: E. E. **Blaise** and H. **Gault.**—The presence of

formaldehyde in caramelised substances: A. **Trillat.** Quantities of formaldehyde varying from traces up to 0·27 per cent. have been found in caramel; the higher the temperature at which the caramel is formed, the higher the percentage of formaldehyde. This fact may account for the observed variation in fermentation of slightly burnt sugar.—The bryological vegetation of the Antarctic regions: Jules **Cardot.** An account of forty-six mosses collected in various Antarctic expeditions.—The sporulated yeasts of Glœosporium: P. **Viala** and P. **Pacottet.**—The influence of grafting on the quality of the grape and wine, and its use in the systematic improvement of sexual hybrids: M. **Curtel** and A. **Jurie.** The evolution of colonies of *Diplosoma spongiforme* and the "displanchtomy" of the ascidiozoids: Antoine **Pizon.**—The male and the sucker of *Nicothoa Astaci*: A. **Quidor.**—The peat deposits of the sea shores of Brittany, to the north of Morlaix, Finistère: L. **Cayeux.**—A whirlwind of very small dimensions: M. **Luizet.**

CALCUTTA.

Asiatic Society of Bengal, January 10.—Types of fever in Calcutta: Major L. **Rogers.**—Description of two new species of cyprinoid fishes from the Helmand basin: C. Tate **Regan.** Five species of fish were taken in the stream of the Helmand basin by the members of the recent Seistan Arbitration Commission. Of these, two, *Scaphiodon macmahoni* and *Nemachilus rhadinaeus*, are described as new.—The origin of mankind (according to the Lamaic mythology): Rai Sarat Chandra Das Bahadur. In the beginning of the *Kalpa*, when living beings had sprung up in the regions of the Rirab (*Sumeru*) mountain, situated above the residence of the four *Dika Pala* (guardians of the world called *Maharaja Kayiko*), two Devaputra (angels) came down to this earth from Heaven, being miraculously transformed into human shape. One of them was *Nima* Rabnang, and the other was *Dawa* Dimeh. These were followed by other angels, whose term of residence in Heaven had expired at the exhaustion of the merit they had acquired before. Thus humanity evolving from heavenly origin in course of time multiplied on earth.—Persian folk songs: Major D. C. **Phillott.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 1.

ROYAL SOCIETY, at 4.30.—An Experimental Inquiry into the Factors which determine the Growth and Activity of the Mammary Glands: Miss J. E. Lane-Claypon and Prof. E. H. Starling, F.R.S.—The Specificity of the Opsonic Substances in the Blood Serum: Dr. W. Bulloch and G. T. Western.—The Internal Anatomy of Somoxys: Lieut. F. Tulloch, R.A.M.C.

CHEMICAL SOCIETY, at 8.30.—Studies of Dynamic Isomerism. Part IV. Stereoisomeric Halogen Derivatives of Camphor: T. M. Lowry.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: F. Darwin, F.R.S.

LINNEAN SOCIETY, at 8.—On a New Type of Stem from the Coal-measures: Dr. D. H. Scott, F.R.S.—Notes on Some Species of Nereis in the District of the Thames Estuary: Dr. H. C. Sorby, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Coast Lines Protected by Chain Cable Groynes: R. G. Allanson-Winn.

GEOLOGISTS' ASSOCIATION, at 8.—Note on an Ostracodal Limestone from Durlston Bay, Dorset: F. Chapman.—(1) Remarks on the Upper Chalk of Surrey: (2) The Devonian Limestones of Lummaton Hill, near Torquay: A. J. Jukes-Browne.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 9.—Hippocrates and the Newly Discovered Health Temple at Cos: Dr. R. Caton.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 5.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Ignition of Nitro-compound Explosives in Small Arm Cartridges: W. D. Borland.

VICTORIA INSTITUTE, at 4.30.—On the Bearing of Recent Oriental Discovery on Old Testament History: Rev. A. C. Robinson.

TUESDAY, MARCH 6.

ROYAL INSTITUTION, at 5.—Food and Nutrition: Prof. W. Stirling.

SOCIETY OF ARTS, at 8.—Imperial Questions in the West Indies: Sir Nevile Lubbock, K.C.M.G.

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: A Plea for Better Country Roads: G. R. Jebb.—Country Roads for Modern Traffic: J. E. Blackwall.—*Probable Paper*: The Widnes and Runcorn Transporter-Bridge: J. J. Webster.

WEDNESDAY, MARCH 7.

SOCIETY OF ARTS, at 8.—Art in Painting and Photography: J. C. Dollman.

ENTOMOLOGICAL SOCIETY, at 8.—The late Prof. Packard's Paper on the Origin of Markings of Organisms: H. Eltringham.

GEOLOGICAL SOCIETY, at 8.—On the Occurrence of Limestone of the Lower Carboniferous Series in the Cannock Chase Portion of the South Staffordshire Coalfield: G. M. Cockin.—Liassic Dentaliidæ: L. Richardson.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, MARCH 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Microscopic Changes in the Nervous System in a Case of Chronic Dourine or "Mal de Coït," and Comparison of the Same with Those found in Sleeping Sickness: Dr. F. W. Mott, F.R.S.—On the Relationship between Hæmolysis and Phagocytosis of Red Blood Cells: Dr. R. D. Keith.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: F. Darwin For. Sec. R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—A New Single-Phase Commutator Motor: V. A. Fynn.

MATHEMATICAL SOCIETY, at 5.30.—On Function Sum Theorems connected with the Series $\sum_{1}^{\infty} x^n/n^2$: Prof. L. J. Rogers.—On Sommerfeld's Diffraction Problem and on Reflection by a Parabolic Mirror: Prof. H. Lamb.

FRIDAY, MARCH 9.

ROYAL INSTITUTION, at 9.—Some Dietetic Problems: Dr. R. Hutchison.

PHYSICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.—Descriptions of twenty-seven Marine Gastropoda, and one Scaphopod, from the Persian Gulf and Gulf of Oman: J. C. Melvill.—Note on *Capulus lissus*, Smith: J. C. Melvill.—Mollusca from a Rainwash, 150 ft. O.D. at Harlton: Rev. R. Ashington Bullen.—Report on a Small Collection of Land and Freshwater Shells from Uganda, with Descriptions of two New Species of Limicolaria and one of Martensia: H. B. Preston.—On New Species of Polyplacophora from South Australia: W. T. Bednall and E. H. V. Matthews.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design of a Two-hinged Spandrel-Braced Steel Arch: R. Freeman.

SATURDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 8, 1906.

A REVISED DOCTRINE OF VALENCY.

Neuere Anschauungen auf dem Gebiete der anorganischen Chemie. By Prof. A. Werner. Pp. xii + 189. (Brunswick: F. Vieweg and Sohn, 1905.) Price 5 marks.

IN 1893 Prof. Werner published his first important paper on the constitution of inorganic compounds, and expounded a new theory for the classification of the large and complex group of substances known as metal-ammonia compounds. Of these compounds a few are common enough, such as the deep blue substance formed by the addition of ammonia to solutions of copper salts, but the greater number do not come within the range of ordinary analytical chemistry; they are for the most part of no industrial importance, and consequently they are scarcely heeded except by a very limited number of chemical workers. The class of cobaltamines which has vexed many a generation of chemical students does not measure the limits of complexity to which these compounds extend, and certainly, without the guiding light of some good theory as to their structure, the metal-ammonia group constitutes one of the most bewildering tracts of inorganic chemistry.

It is therefore a real service that Prof. Werner renders in publishing in this volume (No. 8 of a series of monographs on natural and mathematical science, collectively called "Die Wissenschaft") a full exposition of his theory and an *aperçu* of the compounds to which it specially applies. We must not give the impression, however, that Werner's theory applies only to metal-ammonia compounds. It is a general theory ranging over chemistry as a whole, and is applied to so simple a substance as sulphuric acid. To describe it in a few words is almost impossible. Perhaps the most central thing is the substitution of the idea of association (Anlagerung) for the strict and definite linkage implied in the ordinary valency theory. This idea has, in a vague way, long prevailed in chemistry in the distinction drawn between atomic and molecular compounds. In $CuSO_4$ we are accustomed to represent definite atomic linkages according to the definite valencies of the component atoms. How are we to represent the attachment of $5H_2O$ to $CuSO_4$ in the hydrated salt? The idea that valency is not a sharply fixed quantity, and that it is not necessarily exhausted when a stable compound is formed, is familiar to us in the hypothesis of residual affinity.

Prof. Werner would have us revise our somewhat diagrammatic and artificial ideas of valency. We are to think of an atom as a small material sphere, from the centre of which the attractive force of affinity is exerted uniformly in every direction. Segregation of the affinity into units of valency is not to be supposed; valency is merely to mean the observed proportional numbers in which atoms associate with one another. It is not dependent on one atom alone, but on the nature of all the atoms that form the molecule. The proportion of the affinity which is spent between two atoms is confined to the restricted circular surface of contact [theoretically one would say a point], the *Bindefläche,* and depends in a high degree on the nature of the atoms. Thus, the author adds, we obtain a rational picture to represent the varying valency of an atom, whilst from the dependence of the distribution of the surfaces of contact on the relative magnitudes of the atoms we reach, without further hypothesis, a space configuration of the molecule.

As the simplest possible illustration of the advantage claimed for these views we may cite the formation of sulphuric acid by the union of SO_3 and H_2O. In each of these molecules it is usually considered that the valencies of the atoms are satisfied. That being so, the readiness of the two molecules to unite must be attributed to some selective action. This is found in the tendency for the group (OH) to be formed, and hence we write $SO_3 + H_2O = O_2S(OH)_2$. According to Prof. Werner, on the other hand, we must suppose that neither the sulphur in SO_3 nor the oxygen in H_2O has spent its affinity, and that accordingly the combination of the two molecules is to be represented as follows: $O_3S + OH_2 = O_3S.OH_2$. At the same time he admits that the compound may pass into the configuration $O_2S(OH)_2$. It might seem, then, that there is not much gained. But he claims that the great merit of this view lies in its conformity with that which must be taken of analogous combinations where a secondary arrangement does not take place. Such a case is to be found in the union of halides to form what are, though commonly called double salts, compounds strictly of the same order as oxysalts. Thus we have $KCl + AuCl_3 = KAuCl_4$ analogous to $K_2O + SO_3 = K_2SO_4$. $KAuCl_4$ is as much a potassium salt as K_2SO_4, and, though it may not be impossible to give an ordinary valency formula to some of these compounds, their formation cannot be explained by anything corresponding to the supposed primary cause (the formation of KO groups) in the union of K_2O and SO_3. The attempt to bring double halides as a whole within the ordinary valency doctrine has not been successful.

But, as stated above, Prof. Werner's theory has arisen in connection with the metal-ammonia compounds, and we will conclude this notice with a slight indication of its application there. In the metal-ammonia compounds we have an electropositive atom, a number of (NH_3) groups, and electronegative atoms or groups. It is supposed that the positive atom has the power of associating itself with or *coordinating* a certain number of atoms or groups which must be supposed to be in contact with this central atom and to constitute a sort of first layer. The whole group also forms the positive ion. Beyond and outside this we have negative atoms or groups which give the negative ions.

Luteo-cobalt chloride has the composition

$$CoCl_3 6NH_3.$$

Cobalt is here shown with the valency of a triad, and as a matter of fact the whole of the halogen may be precipitated by silver nitrate. Purpureo-cobalt chloride

is $CoCl_3.5NH_3$, but only two-thirds of its chlorine can be precipitated. In praseo-cobalt chloride, $CoCl_3.4NH_3$, only one-third of the chlorine reacts as an ion, whilst the compound $CoCl_3.3NH_3$ is not ionised at all.

Now, according to Prof. Werner, the coordination number of cobalt in all these compounds is six, that is to say, the cobalt atom is in all cases associated with six groups or atoms. Outside this are the negative ions. The valency of the positive ion diminishes as the electronegative element in it is increased. Thus we have the following series of compounds:—

$$[Co(NH_3)_6]'''Cl_3;\ [Co(NH_3)_5Cl]''Cl_2;\ [Co(NH_3)_4Cl_2]'Cl;\ \text{and } [Co(NH_3)_3Cl_3]^\circ.$$

It will be seen that here again the essence of the theory lies in the idea of coordination or association as distinct from ordinary valency with its separate linkages. The same ideas may be extended to water of crystallisation in hydrated salts.

This slight sketch will, it is feared, give but a poor idea of the ingenuity and comprehensiveness of Prof. Werner's theory, but it is all that the limits of space allow. The book before us may be strongly commended to all who are interested in the development of chemical theory, and though, no doubt, the new doctrine cannot by any means be called unexceptionable, there is much in Prof. Werner's book that is interesting and stimulating quite apart from the clear exposition of the particular views it is intended to disseminate.

A. SMITHELLS.

THE DANISH FISHERY INVESTIGATIONS.

Meddelelser fra Kommissionen fra Havundersøgelsen. Serie Hydrografi, Bd. i., Nos. 7–8; *Serie Fiskeri*, Bd. i., Nos. 4–8; *Serie Plankton*, Bd. i., No. 3. (København, I Kommission Hos C. A. Reitzel, 1905.)

THE reports issued by the Danish section of the International Fisheries Investigation Organisation deal to a greater extent with purely biological matters than do the publications of the corresponding British committee. Thus of the present instalment of reports two relate to hydrographical researches, one to plankton studies, while five deal with the life-histories of species of fishes of economic importance.

The hydrographic reports consist of an investigation by Mr. J. P. Jacobsen on the solubility of oxygen in sea-water, with a description of the methods and apparatus employed. Mr. J. N. Nielsen also contributes an account of several hydrographic cruises made by the *Thor* in the summer of 1904 on the north coast of Iceland, and a discussion of the results obtained. The sea-water on the north coast of Iceland is derived from warm Atlantic water in the Denmark Strait the Irminger current—and from much colder, but lighter, water of Arctic origin, which comes from the East Greenlandic polar current. The climate of the North Icelandic coast is dependent to some extent on the relative distribution of these two contributing currents. The Irminger current flows north along the west coast of Iceland, and then, as a result of the earth's rotation, along the north coast. This latter cause, and also the interference of the East Greenlandic polar stream, produce a further rotation of the current, so that it may even round the north-east coast of Iceland and flow south. Along its whole course the Irminger current yields up heat to the atmosphere, cooling by convection as it does so, so that even the lower layers give up their heat. Land-water, produced by the melting of ice and snow masses, cools down the coastal waters, and, being of lower salinity, causes a surface current seawards during the summer and an undercurrent landwards. In winter the lower temperature of the land cools the sea-water, which then sinking in consequence of its greater density, flows seawards as an undercurrent, while it is replaced by a surface current moving towards the land.

The distribution of the comparatively warm Irminger current is affected by the presence of drift ice; in those years when drift ice is abundant on the Icelandic coasts, the cold (though less dense) Arctic water spreads over the surface, and blocks to a variable extent the eastward passage of the Atlantic water. But it also prevents the conduction of heat from the latter to the atmosphere, and as a result, during these hard ice years, the mean temperature of the air of the first six months of the year is much lower than in those years when drift ice is absent or less abundant during the months in question. In this connection the suggestion that telegraphic cable communication with Iceland, and a coast telegraph line, should be established is of considerable interest, for the advent of the ice can usually be foretold by observations of the temperature of the sea.

Not only does the temperature of North Iceland during the winter depend on the distribution of the eastern branch of the Irminger current, but the fisheries vary in an analogous manner. This appears to be the case with the great herring fishery, and cod appear also to travel to the west, north, and east of Iceland with the current, not appearing in abundance until the temperature of the water reaches a certain value. The pelagic larvæ of the latter fish are also distributed by the current, as well as by the offshore and inshore movements of the water due to the cause mentioned.

A short note by Mr. C. G. J. Petersen on the occurrence of Leptocephali is of exceptional interest. It is well known that finds of this stage of the common eel have been very rare in northern waters. Dr. Petersen tells us that it occurred to him to look for these larvæ in warm and deep Atlantic water, using special fishing apparatus. Accordingly in May, 1904, Dr. J. Schmidt found a typical Leptocephalus at a station south-west of the Færöe Isles, in water more than 1000 metres in depth, and in a postscript it is also added that great quantities of *Leptocephalus brevirostris* have been found by Schmidt "in the depths of the Atlantic," presumably near the same place. Dr. Petersen concludes that it is here, not in the Baltic or North Seas, that the eels of Northern Europe breed, passing in their migrations either the North Sea or

the English Channel; and he discusses the value of this discovery from the point of view of the Swedish, Danish, and German eel-fisheries. We await with considerable interest the further account of these remarkable investigations.

The other reports are also of considerable interest. Mr. A. C. Johansen writes on the life-history of the young post-larval eel. Mr. A. S. Jensen contributes a paper on the occurrence of the otoliths of Gadoid fishes in the bottom deposits of the polar seas between the Færöes, Jan Mayen, and Scotland. Samples of mud obtained from the sea-bottom in these regions frequently contained otoliths derived from various Gadus species. Nevertheless, the trawling operations of the *Michael Sars* showed that the cod does not live at the bottom of these seas. The occurrence of Gadus otoliths is therefore to be explained by the horizontal migration of these fishes from the shore grounds near the surface of the sea. Some observations made by Mr. T. Scott on the occurrence of whiting otoliths in the stomach of the porpoise show also that these structures may be distributed over wide areas of sea-bottom, since whiting are eaten in large numbers by the porpoise and the otoliths may be evacuated in an undecomposed condition. This is presumably the case also with other of the smaller gadoid fishes.

The remaining papers include a study of the post-larval stages of Gadus, spp., and of *Brosmius brosme* by Mr. J. Schmidt, both notable additions to the literature of the subject, and a description of several new Peridinians by Mr. O. Paulsen.

JAS. JOHNSTONE.

THE EVOLUTION OF BIOLOGY.

Geschichte der biologischen Theorien, seit dem Ende des siebzehnten Jahrhunderts. Teil i. By Dr. Em. Radl. Pp. vii+320. (Leipzig: W. Engelmann, 1905.) Price 7s. net.

ALTHOUGH biology is now permeated by the evolution idea, and has continually before it the ideal of giving a genetic description of the present phase of the animate world, there is some reason to fear, as Dr. Radl indicates, a growing apathy towards the study of the evolution of the science itself. Whether it be that many workers share Nietzshe's view that the study of history paralyses the intelligence, or that they feel it their primary business to make history, not to read it, or that they regard historical inquiries as the philosopher's task, not theirs, it seems certain that too little attention—in our investigations, theories, and teaching alike—is paid to the historical evolution of the science. A notorious example may be found in the biological work of Herbert Spencer, who, though he had almost accidentally found inspiration from a slight acquaintance with the work of von Baer, deliberately set his face against looking for more. He preferred to think for himself. But all cannot be excused as we excuse Spencer, and even his work suffered from his peculiarly detached independence of outlook. Whether we will or no, the past lives in the present, and he who thinks himself most emancipated from all scientific tradition may be a signal instance of the rehabilitation or recrudescence of doctrines which characterised his unknown intellectual ancestors. It is not as if scientific discoveries were successive special creations which had their day and ceased to be, giving place to others unaffiliated to them. On the contrary, as Dr. Radl's book, and any other piece of careful historical work, shows, biology is an evolution. Generalisations grow and vary, there is an amphimixis of ideas, there is an adaptation to the social environment, there is a struggle for existence and a survival of the fittest.

Without much discussion of the factors which brought about the scientific renaissance, Dr. Radl begins by showing how the influence of Aristotle persisted in men like Cæsalpinus, Harvey, Glisson, and Redi. The second chapter shows how the mechanical modes of interpretation, vindicated by the physicists, began to insinuate themselves into biology, through Descartes, Borelli, Fr. Hoffmann, and Dr. Willis. The advent of the microscope is then discussed, and an interesting account is given of the work and influence of Malpighi and Swammerdam. A reaction from Cartesian mechanism found expression through the genius of Leibnitz, and vitalism its first thoroughgoing exponent in Stahl.

The fifth chapter deals with the first half of the eighteenth century, with the successors of Malpighi and Swammerdam, and with the early preformationists, such as Bonnet, Haller and Buffon. Then follows an account of Linné's systematic work. Wolff is the central figure of the next chapter, which deals with the foundation of the epigenetic theory. Gradually the conception of individual development expanded into that of racial evolution, but even more in the minds of philosophic thinkers than of naturalists. The ninth chapter gives us the history of the rise and progress of morphology, illustrated especially with reference to Cuvier and Étienne Geoffroy St. Hilaire, Jussieu and P. De Candolle. After a brief chapter on Bichat as representative of vitalism at the end of the eighteenth century, the author passes to a more detailed study of the German "Naturphilosophie," as illustrated by Herder, Kant, Fichte, and Schelling among philosophers, by Kielmeyer, Goethe, Oken, Blumenbach, and Treviranus among biologists. The present volume merely begins the story of the evolution of evolution theory, the two last chapters being devoted to Erasmus Darwin and Lamarck.

Having indicated the scope of this valuable historical treatise, we must now express our high appreciation of the author's workmanship. He shows a first-hand acquaintance with the works with which he deals, and yet he has not allowed himself to be overwhelmed by his scholarship. He has a keen selective instinct and a rare terseness, and although he has written in what was to him a foreign language, his style is lucid and often vivid. One cannot but be impressed in reading the interesting history with Dr. Radl's calmness and independence of judgment; he is neither depreciative of men like Oken nor eulogistic of men like Lamarck; he states their case with justice, and gives chapter and verse for his judgments. In some cases,

e.g. that of Lamarck, his estimate is by no means that which many authoritative writers have expressed.

As we lay aside the volume some general reflections remain convincingly with us—that the history of biology is a rational evolution, and at the same time inextricably intertwined with social evolution; that the same general ideas are re-incarnated century after century in more evolved forms; that each generation meets the same old difficulties on a higher turn of the spiral; that clearly thought-out conceptions which seem for a time to be vanquished re-assert themselves with renewed vigour, and find their nosition in a more complete synthesis. The modern biologist, intent on new discoveries, has no use for Aristotle, Descartes, and Leibnitz, but their influence may be upon him none the less. In speaking of the aqueduct of Sylvius, the Malpighian tubules, the Graafian follicle, or the Cuvierian organs, we quaintly acknowledge our debt to the past, but perhaps we betray our indebtedness more when we are least conscious of it, for even the most modern system of biology is, like our own body, a veritable museum of relics. J. A. T.

STOMATA AND PHYLOGENY.

Der Spaltöffnungsapparat im Lichte der Phylogenie. Ein Beitrag zur "phylogenetischen Pflanzenhistologie." By Dr. Otto Porsch. Pp. xiv+196. (Jena: Gustav Fischer, 1905.) Price 8 marks.

THIS work, as its title announces, is an attempt to use the stoma as a mark of relationship, and thus to make it serve as a guide to the phylogeny of plants. The author is filled with a pleasant enthusiasm for his subject, and this he contrives to convey to his readers, who, whether or no they are in complete agreement with his views, will not deny that he has produced an interesting and suggestive book. Personally, we think he has done more, and that his work has decided value. He begins by showing (what has to some extent been shown before) that definite types of stoma run through certain classes or natural orders. He makes it clear that these types remain recognisable even in plants exposed to various environments. The gymnospermous type, for instance, occurs in plants of such diverse habit as Bowenia, Gingko, Dioon, and Gnetum.

The author allows that the gymnosperm type is essentially a stoma adapted to xerophytic conditions. This brings us face to face with what is a difficulty in inquiries of this sort—namely, how far persistence of type is due to adaptation. This is especially difficult in regard to the xerophytic habit, because our knowledge of the conditions which make this habit of value is recent, and probably incomplete. It is only comparatively lately that conditions of life in a salt-marsh, an English heath, and in the alpine regions of the tropics have been recognised as equivalent environments in regard to transpiration. The author is, however, fully aware of the difficulty in question.

It is interesting to find the gymnospermous stoma occurring in Casuarina, a genus known to possess morphological characters which have suggested that it may be an offshoot from an ancestor common to gymnosperms and angiosperms. In concluding this section the author has some remarks on the minuter taxonomic value of the stoma, *e.g.* in Dasylirion, where the stomatal characteristics may be used to distinguish the species. He also directs attention to the Commelinaceæ and Eriocaulaceæ, and to the genus Eucalyptus, in all of which the stoma is characteristic. As showing the possible value of the stoma to the palæobotanist he quotes the case of a fossil Potamogeton recently shown by its stomatal type to belong to the Loranthaceæ. Porsch gives an interesting account of reduced and rudimentary stomata in the true leaves of Ruscus, in parasites, and in submerged plants. The latter case is especially interesting because here the stomata can hardly be of use for gaseous exchange. But in the petals of flowers or the bulky stems of holoparasites it is clear that they may be of importance for respiration. This is a function of the stoma which Porsch does not sufficiently discuss; thus in referring to the stomata of petals he considers transpiration alone. The fact that large petals occur devoid of stomata while others (Galtonia) have perfect ones shows that the question is in need of physiological inquiry.

In another interesting section the author describes the stomata of seedling leaves, which are generally of an undifferentiated type, even when the adult leaves have highly specialised stomata, *e.g.* in Hakea, *Spartium junceum*, &c. This seems at first sight a case of "recapitulation," but the author is careful to supply an alternative view, viz. that in the early stages of existence a plant is less subject to drought, so that the simple stomata of the seedling may be an adaptation to conditions less rigorous than those to which the adult is exposed. The author, however, accepts, with certain reservations, the recapitulation point of view.

The last section of the book deals with stomata in relation to alternate generation. Porsch holds (with Wettstein) the sporophyte to be an adaptation to life on dry land in contrast to the gametophyte, which retains aquatic characters. Taking the Bryophytes as the lowest class in which stomata occur, he again follows Wettstein in placing the mosses in the lower division, the liverworts being a more specialised form. It is in harmony with this view that in the mosses stomata should occur only in the sporophyte. Among the normal two-celled stomata are occasionally found others of the four-celled type. This he looks on as a "reminiscence" of an earlier form, in which the intercellular spaces open externally in the simplest manner between four epidermic cells.

In the liverworts, on the other hand, the gametophyte possesses openings which function as stomata. There is only one group in the liverworts which exhibits a highly organised sporophyte, and here in Anthoceros we find true stomata having a pair of guard cells, which are probably of a higher type than occurs elsewhere among the Bryophytes.

Among the Pteridophytes the most interesting fact is that the stomata are of a type that may be supposed to be the forerunner of the gymnospermous stoma. The characteristic lignification is not always present

but in some cases, *e.g.* in Todea, we find lignification almost identical with that of certain gymnosperms.

On the whole the author may be congratulated on having attained the end which he had in view, namely, by tracing the history of a definite organ through the vegetable kingdom, to demonstrate the fruitfulness of the phylogenic method. F. D.

OUR BOOK SHELF.

Economic Geology of the United States. By Heinrich Ries. Pp. xxi+435. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1905.) Price 2.60 dollars net.

THIS volume embodies the elementary course of economic geology at Cornell University, where the author is assistant professor. Some knowledge of geology and mineralogy on the part of the student is presupposed, and the work deals exclusively with North American mineral deposits. At the same time North America is so preeminently the continent of mineral deposits, nearly all types and forms being represented within its vast mineral areas, that a treatise on American economic geology is nearly the same thing as a study of mineral deposits in general.

The mode of arrangement differs from that of other books on the same subject in that predominance is given to the non-metallic minerals, the value of the production of which exceeded that of the metallic minerals in 1903 by thirty million pounds. The twenty chapters into which the book is divided deal respectively with (1) coal; (2) petroleum, natural gas, and other hydrocarbons; (3) building stones; (4) clay; (5) lime and calcareous cement; (6) salts; (7) gypsum; (8) fertilisers; (9) abrasives; (10) minor non-metallic minerals; (11) mineral waters; (12) soils and road materials; (13) ore deposits; (14) iron; (15) copper; (16) lead and zinc; (17) gold and silver; (18) silver lead; (19) aluminium, manganese, and mercury; and (20) minor metals.

In each chapter the treatment is the same. An account of the minerals is followed by particulars of their distribution in the United States, with sketch maps, details of their use, recent statistics of their production in the United States and in the world, and a carefully selected bibliography. The twenty-five plates reproducing photographic views of mines and the ninety-seven diagrams in the text are alike excellent. Altogether the work is an admirable one, and we strongly commend it to teachers in this country as a source of concise, accurate, and recent information regarding the mineral deposits of the United States.

Botanische Jahrbücher. Edited by Dr. A. Engler. Vols. xxxiii., xxxiv., and xxxv. Parts i.–iii., with index vols. i. to xxx. (Leipzig: W. Engelmann, 1902–5.)

THE series of papers produced under the direction of Dr. Engler, as the "Beiträge zur Flora von Afrika," continues to engage the attention of workers at the botanic museum in Berlin. The papers that give merely descriptions of new species are chiefly serviceable to monographers, but the results become more interesting when they are collated for a genus or an order, as in the revision of the Ochnaceæ by Dr. Gilg. In a short article that will be found in *Beiblatt,* No. 79, Dr. Engler summarises the general progress of the study of African botany in Berlin, and indicates where further collections and explorations are required. He refers to Dr. Fülleborn's collections of the lower algæ and Bacillariales taken from Lake Nyassa. They have been examined by Dr. Schmidle and Dr. Otto Müller, and their descriptions and deductions are published in these volumes. Other systematic compilations include a contribution to the flora of Madeira and the Canary Islands by Mr. J. Bornmüller, some notes by Drs. Gilg and Loesener on the flora of Kiao-chau, the Chinese territory that was occupied by Germany in 1898, and the "Fragmenta Phytographiæ Australis occidentalis," written by Drs. Diels and Pritzel. Among the cryptogamic contributions, Mr. G. Hieronymus publishes an account of the pteridophytes collected in Ecuador and Colombia by Mr. H. C. Lehmann, German Consul, and Mr. E. Lemmermann deals with the algal vegetation in the Sandwich Islands. Among the ecological papers, Mr. J. Holmboe sketches the botany of the Norwegian moors. Mention should also be made of the notices in the *Beiblätter* of addresses delivered before the Society of Systematic Botanists, of which not the least interesting is that by Prof. K. Fritsch discussing the systematic position of the monocotyledons.

The index to the first thirty volumes published in 1904 is an important reference book to systematic botany from 1881; the systematic index, and the catalogue under countries, will be found most useful.

The Practical Photographer. Edited by the Rev. F. Lambert. (Library Series.) No. 27, *Photographic Optics and Lenses,* pp. xxiv+64. No. 28, *The Optical Lantern for Projection and Enlarging,* pp. xxiv+64. (London: Hodder and Stoughton.) Price, each vol., 1s. net.

THESE two volumes form the December and January issues of this useful series of photographic handbooks. As usual, each is prefaced by a short essay on the pictorial work of some well known photographer written by the editor, and in these cases we are made acquainted with the photographic work of Mr. W. A. I. Hensler and Mr. Charles H. L. Emanuel. They are also accompanied by a series of reproductions from the best works of these photographers, which illustrate, more than words can describe, the particular styles of treatment.

In the volume on photographic optics we have a series of notes by numerous authors on various points relating to lenses. These are more or less miscellaneous in their nature, but the several items are generally clearly described, and may prove serviceable. Numerous diagrams and process reproductions are included in the text.

The volume on the optical lantern contains many useful wrinkles which will materially aid the beginner and prove useful to those who are already acquainted with the manipulation of a lantern. Forms of lanterns, illuminants, condensers, reflectors, are all fully treated, and in addition there is much miscellaneous information on lantern optics, and sundry items pertaining to lantern work. Included in these pages are process reproductions of several photographs, details about which are given under "Pictorial Notes."

The Sanitation of a Country House. By Dr. Harvey B. Bashore. Pp. vi+103. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.)

THIS little book would form a useful, popular, and non-technical guide on sanitary matters to anyone about to build a country house, but is necessarily one for America, and the practice recommended and details given would not always suit this country. The illustrations and diagrams, sixteen in number, are excellent.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Perkin Jubilee and Chemical Industries.

AT the meeting held at the Mansion House on February 26, with the Lord Mayor in the chair, many men of position and influence in the scientific world met to do honour to Dr. W. H. Perkin, and to agree to celebrate the jubilee of his discovery of the first coal-tar colour. Whilst all felt not only the importance, whether from a purely scientific or from an industrial point of view, of this discovery, and whilst they all applauded Perkin's researches in other branches of science and his modest and retiring bearing throughout, the fact could not be lost sight of that although England was the country in which the coal-tar industry was founded, it had practically, since those days, passed out of our hands into those of the Germans. The cause of this, I remarked, was not due to any want of knowledge or power on the part of Dr. Perkin himself, but rather to the absence of appreciation by capitalists and others engaged in industry of the importance of scientific method, or, in one word, to English Philistinism, the result being that the successful prosecution of a new industry the very existence of which depends on high scientific attainment was impossible. In corroboration of this opinion, which was also expressed in an excellent article in the *Times* a few days before the meeting, I ventured to direct attention to the fact that, being at that time (fifty years ago) engaged in building up a chemical school at Owens College, I knew three talented young German chemists whose names have since become watchwords in Germany (Caro, Martius, and Pauli) who were then employed in chemical works in Manchester and the neighbourhood. These men were intimately acquainted with the colour industry, both in theory and practice, so far as it had then advanced, and were perfectly capable, as was afterwards proved, of carrying it on successfully. Had they been supported by men of financial light and leading in Lancashire the industry might have flourished in this country. Not, however, finding the necessary support here, they returned to Germany, where they became the leading members of the great colour works at Ludwigshafen, Höchst, and Berlin.

But the Germans, not content with having secured an industry the value of which is reckoned at 50,000*l.* annually, are preparing for future attacks. On the very day of the Perkin meeting I received a letter from my friend Dr. Hagen, the director of the Physikalische Reichsanstalt in Charlottenburg, in which he informs me of the determination to found a corresponding Anstalt for chemistry, and in the last number of the *Berichte* I find a statement made by the committee of the German Chemical Society in support of this proposal. In this they point out, in the first place, that the due development of chemistry, influencing as it does so powerfully national life, cannot be ensured by individual effort, and that the establishment of a Reichsanstalt for chemistry is for this purpose necessary. In the second place, they proceed to indicate a large number of questions requiring solution which can only be satisfactorily answered by long-continued research. They conclude by the remark that such an institution must be of a national character, inasmuch as the subjects dealt with are of national importance, influencing the welfare and progress of the country.

Here we have a true trumpet call. Will England answer to it or will she otherwise make up her mind again to take a second place? In his admirable letter on "Science and the Industries" in the *Times* of Saturday, March 3, Prof. Silvanus Thompson points out that the electrical industry, and that of the manufacture of steel, are likely to fall, if they have not already fallen, into the hands of Germany and America, and insists, as many of us have been doing for the last twenty years, on the necessity of our commercial and educational leaders becoming aware of the absolutely vital nature of the bearing of scientific research on industrial prosperity. This conclusion is emphasised in a letter printed in the *Times* of March 6 from Sir Joseph Lawrence, in which he urges the plea that English manufacturers are too poor and too closely run by competition to be able to afford scientific leading! This is indeed an appeal *ad misericordiam!*

The long and the short of it is that the Germans, and the Americans I may add, see this, and are strenuously working the principle into practice, whilst we remain "blind leading the blind." When will our eyes be opened?

HENRY E. ROSCOE.

Cooperation between Scientific Libraries.

DR. BATHER's letter in your issue of March 1 is one which deserves the hearty support of all scientific workers, in the United Kingdom at least. I have long felt that the whole of the literature indexed in the International Catalogue ought to be available for reference in some one locality, and preferably in London. In my address as president of the Chemical Society in 1894, foreshadowing the time when our meeting-room would be too small, I ventured to point out that "This is a difficulty that threatens to oppress all the Burlington House societies, and must become more pressing as the importance of bringing all societies having cognate aims into juxtaposition is realised. Perhaps some day our friends and neighbours the artists will have found quarters elsewhere more suited for the display of their works—for they appear already to have far outgrown the space at their disposal, and to be therefore obliged to impose undesirable limitations on exhibitors; when this occurs, it should be possible to find accommodation more adequate to the needs of science and fit presentment of its Imperial importance" (Chem. Soc. Trans., 1894, 358).

Since then, the University of London has vacated the portion of Burlington House in which it long had its quarters, and the Royal Society has let slip a golden opportunity of securing these rooms for its own use, and at the same time of affording to other cognate societies—including the British Association—the increased accommodation they so much need. The quad. roofed in would make a magnificent reading-room. Sad experience teaches me that there is little hope in this country that those who are engaged in scientific work will consent to work together for some serious common purpose: apparently every little show must be run separately; but if they could be persuaded—if the Royal Society would for once have courage and lead—much might be done to further a project such as Dr. Bather advocates and bring it to a practical issue at no distant date.

HENRY E. ARMSTRONG.

THE letter of Dr. Bather on the above subject in NATURE of March 1 (p. 413) is of much interest.

My experience in the preparation of the Royal Society Catalogue of Scientific Papers fully confirms the statements of Dr. Bather and of Dr. Muir, to whose paper he refers, as to the inconveniences arising from want of coordination between different libraries.

When we were commencing the indexing of the scientific papers from 1884 to 1900, it was necessary to ascertain the names of new serials that had come into existence since 1883, and also to take note of the serials that had been omitted from the twelve volumes of the Catalogue already published. Members of our staff were sent to some of the scientific libraries in London, and a list was thus obtained containing more than 1400 serials of various degrees of importance. Many of these were, of course, unsuitable for our purpose; a large number, however, were incomplete, single volumes and sometimes single parts only being available. These separate portions had probably come to the various libraries as specimens, or for the purpose of obtaining exchanges; and if there had been a general agreement between the libraries of London, arrangements might have been made to maintain such serials complete in one or other of the libraries. If a joint handlist, as suggested by Dr. Bather, had been in existence, much time expended by us in searching for these serials would have been saved.

A few days ago I heard that the Royal Society of Edinburgh is engaged in considering a scheme of cooperation amongst the principal scientific libraries of Edinburgh and Glasgow, and that a complete list of scientific serials in these libraries is to be compiled. It would be of great advantage if a similar scheme could be carried out in

London. In the libraries of the learned societies at Burlington House alone there are many serials in duplicate; some of these might profitably be replaced by others which are not at present in these libraries. It often happens that books and serials are sent to library committees on approval, and are rejected because they are thought to be more suitable for other libraries; but attempts are not always made to ascertain whether these other libraries possess them. At the present time, from want of space and other causes, the duplication of periodicals at Burlington House is avoided as much as possible.

In the subject index to the scientific literature of the last century which the Royal Society is preparing, it is proposed to indicate, in the introductory list of serials, the libraries in which the cataloguing has been done, and also to mention other libraries in which the books may be found. This will be useful to workers, but it cannot be quite complete, for the task would be too great to undertake in its entirety. For example, there are more than 600 serials which contain mathematical papers, and it would be impossible to name all the libraries where they are found.

March 3. HERBERT MCLEOD.

The Bees of Australia.

UP to the beginning of 1905, 224 species of wild bees had been recorded from Australia, no less than 183 of them having been described by F. Smith, of the British Museum. I had the opportunity in 1904 to study Smith's types at the British Museum, and since then I have worked up the unnamed Australian material belonging to that institution, with the exception of some species of Halictus yet to be examined. The following list shows the genera found in Australia (including Tasmania), New Zealand, and the Austro-Malay Islands (taking the region as defined by Wallace), and the number of species in each.

Family.	Genus.	Australia.	New Zealand.	Austro-Malay Islands
Colletidæ	Phenacolletes *	1	—	—
	Paracolletes (sens. lat.)	52	8	—
	Anthoglossa *	4	—	—
	Cladocerapis *	1	—	—
	Andrenopsis *	1	—	—
Prosopidæ	Hylæoides *	2	—	—
	Callomelitta *	1	—	—
	n.g. aff. Callomelitta*	1	—	—
	Prosopisteron *	1	—	—
	Euryglossa *	29	—	—
	Prosopis	54	7	6
	Stilpnosoma *	2	—	—
Andrenidæ	Sphecodes	1	—	1
	Halictus	22	3	1
	Parasphecodes *	18	—	—
	Nomioides	1	—	—
	Meroglossa *	1	—	—
	Nomia	19	—	21
	Stenotritus *	2	—	—
	Andrena ?	3	—	—
Family ?	Gastropsis *	2	—	—
Panurgidæ	Scrapter ?	2	—	—
Ceratinidæ	Ceratina	—	—	6
	Exoneura	5	—	—
	Allodape	3	—	1
Xylocopidæ	Xylocopa	2	—	27
	Lestis *	2	—	—
Anthophoridæ	Anthophora	11	—	6
	Saropoda	2	—	1
	Tetralonia	1	—	—
Melectidæ	Crocisa	8	—	7
Nomadidæ	Nomada	—	—	2
Megachilidæ	Megachile	50	—	57
	Lithurgus	4	—	—
	Thaumatosoma	1	—	—
	Ctenoplectra	—	—	1
	Coelioxys	2	—	4
	Parevaspis	—	—	1
	Anthidium	—	—	1
Apidæ	Apis	(1 introd.)	—	3
	Trigona	5	—	7
		317	18	153

The list proceeds from the most primitive bees up to the most specialised. The genera marked with an asterisk are wholly peculiar to Australia, so far as known; and it will be observed that, as with the mammals, there are many endemic genera of a primitive type. Lestis is the only endemic genus allied to the ordinary long-tongued bees, and that consists of two closely allied species, which represent an offshoot from Xylocopa, probably not of very ancient date. True Xylocopa, it will be noticed, just enters Australia (but one species is common in the north), but is rich in species in the Austro-Malay Islands, and extends into Asia, Europe, Africa, and America. The Xylocopas are the large carpenter bees, which nest in wood, and may be transported across the water in floating trees. Until recently, the genera Thaumatosoma and Exoneura were supposed to be peculiar to Australia, but the first has now been found in Burma and the second in Syria. They may possibly be genera which are verging on extinction, but as each differs only in one important particular from its nearest ally (these allies being Megachile and Allodape respectively), it is not impossible that they arose by parallel mutations in the widely distant localities in which they occur, quite independently.

The most interesting of the primitive genera is Phenacolletes, based on a new species (*P. mimus*) discovered by Commander J. J. Walker on the *Penguin* Expedition. The Colletid bees are supposed to have been derived from the fossorial wasps, and Phenacolletes is so like certain wasps that I was not sure whether it was a wasp or a bee until I had examined its pubescence with a compound microscope. Unfortunately, we know nothing of the habits of this insect, but Commander Walker kindly informs me that it was taken on November 12, 1890, at Turtle Bay, north end of Dirk Hartog Island. He finds in his journal for that day that "an upright growing shrub with ovate glabrous leaves and large whitish-rosy mallow-like flowers" was the only plant which seemed to be at all attractive to insects, so perhaps the Phenacolletes came off that.

I have supposed that the bees with emarginate tongues (Colletids and Prosopids) arose from the wasps independently from those with pointed tongues, this seeming the more likely, because the wasps themselves exhibit both types. However, there are indications that in Australia the first form may have become modified into the second within the limits of the bee-group. This is especially suggested by the tongue of Callomelitta, and by one of the new species placed for the present in Paracolletes.

The new genus allied to Callomelitta, indicated in the table, is for *Sphecodes antipodes*, Smith. Colonel Bingham very kindly made a critical examination of this species at my request, and found that it was not a Sphecodes, but belonged to a new genus differing from Callomelitta in the shape of the thorax, pubescence of hind tibiæ, &c. It will undoubtedly prove an important form from the standpoint of the evolutionist.

The species marked as Andrena? and Scrapter? stand in our lists as members of these northern genera, but they have not been critically examined recently, and it is questionable whether they are rightly classified. The name Mellitidia has been applied to the so-called Andrena of Australia, and it is probably valid. Nevertheless, there are some undoubted cases of well known northern genera having endemic Australian species, while they have none, so far as known, in the Austro-Malay region. These are Nomioides (found from Burma to Europe) and Tetralonia (India to Europe, &c.); Saropoda (also European) is really in the same category, as the single Austro-Malay species is one of the Australian ones, which has reached the Aru Islands. The case of the Tetralonia seemed a little doubtful, but Colonel Bingham has critically examined Smith's type, and reports that it is a true Tetralonia, but is a female, not a male, as Smith had it. Lithurgus is also a genus of Europe and Asia, and likewise Africa, which has Australian species, though none are known from the Austro-Malay islands. In this case, it is practically certain that the genus is dispersed more or less through the islands, and has been overlooked, for one of the Australian species is exceedingly close to one of India.

Gastropsis, placed by Ashmead in the Andrenidæ, is apparently allied to the European Meliturga, and is in a

way intermediate between the two groups (long-tongued and short-tongued) of pointed-tongued bees. Cladocerapis and Prosopisteron are extraordinary endemic genera, which do not lead in the direction of anything known elsewhere.

It will be observed that the native bee-fauna of New Zealand is very poor, and quite lacking in distinction. Two of the genera are world-wide, while the third (Paracolletes) is found only in New Zealand and Australia, the species of the two regions being quite closely allied. It would seem that New Zealand received its bees in comparatively recent times from Australia (one of the species of Prosopis is even identical with an Australian one), and it may be added that all the affinity is with the southern part of Australia, especially Tasmania. There is still a possibility, of course, that New Zealand may contain some ancient endemic genus, which is now rare and has been overlooked by collectors.

The bees of the Austro-Malay islands are not at all adequately known, though we have a good idea of the general facies of the fauna. Most of the species were discovered by Wallace; I find that about a dozen were known before Wallace went to the islands, about seventy-four were added by him, and sixty-six have been discovered since. The species of Celebes are best known (41), but from Amboina we know only 9, Lombok 3, Timor 8, Ceram 3, Bourn 3, New Caledonia 4, Timor Laut 1, and so forth. It is evident that a very rich field lies before the collector in this region; but it is curious that so far we have not a single endemic genus of bees from the Austro-Malay islands, and it appears probable that few or none exist. Instead, we have numerous species of widely dispersed tropical genera; a varied, but not, apparently, very isolated fauna. The contrast with Australia is extreme. Of the eighteen genera represented, only six are even confined to the eastern hemisphere, these being Crocisa,[1] Allodape, Aspi, Saropoda, Ctenoplectra, and Parevaspis.

To sum up, it is apparent that Australia posesses a very old and long isolated bee-fauna, containing types which seem to link, in greater or less degree, the bees and fossorial wasps, the emarginate-tongued and pointed-tongued bees, and the long-tongued and short-tongued bees. It is therefore evident that the study of this fauna is likely to yield much of interest in the future; and, it must be added, there is little doubt that the number of species awaiting discovery far exceeds the number already discovered. On the other hand, we find in Australia also a more modern fauna, containing even a few species quite identical with those of the Asiatic mainland, and several closely allied thereto. Such are certain species of Nomia, Xylocopa, Anthophora, and Trigona. Of such forms, it appears that they are either strong fliers (as Anthophora) or else they have the habit of nesting in trees (as Trigona), and thus it is not difficult to understand how they crossed the sea. None of these genera, however, have reached New Zealand, which is not only too remote, but also out of the path of suitable marine currents. In the case of certain cosmopolitan genera which have numerous Australian species, such as Prosopis and Megachile, it is to be noted that only a few of the species are specially related to those of the Malay Islands and Asia; the others constitute part of the peculiarly Australian fauna, although they have not become generically altered.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, U.S.A.

The Intelligence of Animals.

IN his review of Father Wassmann's book (NATURE, February 1, p. 351) Lord Avebury dissents from Father Wassmann's conclusion that the sagacity of ants is "instinctive and essentially different from intelligence and reflection," and repeats the opinion which he has held for many years, that "it is difficult altogether to deny to them the gift of reason." The following incidents, which I observed on a footpath in the Donetz Coalfield, in Russia, in the summer of 1898, appear to me to show that the insects here referred to possess both intelligence and the gift of reason, and, therefore, to lend a general support of Lord Avebury's views.

Numerous small black-beetles, about three-eighths of an inch in length, were busily engaged in rolling, hither and thither, balls of cow-dung, about half an inch in diameter, which they had cut away from the edge of a still soft mass of that substance that lay near the middle of the path. As a rule, two insects were engaged in rolling each ball, both walking on their hind legs with their fore-feet resting on the upper curve of the ball—the one behind pushing and walking forwards, the one in front pulling and walking backwards. When the ball commenced to roll on any declivity it passed over the body of the one in front, which then lost its hold and was left behind. But the other always held on tightly to the ball, and was carried over and under it, several times in succession, until the ball either ceased rolling or the insect was thrown off. In the latter case the beetle followed to the bottom of the slope on foot, and usually recovered the ball without difficulty.

The principal slope upon which these disasters happened constituted one bank of a small dry water-course about six inches deep. The length of the bank from top to bottom was ten or twelve inches. The dry bed of the water-course was slightly inclined. In one instance, in which the beetle was thrown off at the fourth or fifth revolution of the ball, the latter rolled to the bottom of the bank, and then, turning at right angles to its former direction, continued to roll down the bed of the water-course to a further distance of nine or ten inches. The beetle followed to the foot of the bank, but did not find the ball where it obviously expected to do so. After hesitating and moving about in various directions to a distance of an inch or two, it ran down the bed of the water-course to a distance of three or four inches, returned, ran down again to a greater distance, returned a second time, then ran down to within two inches of the ball, but, failing to find it, gave up the quest and climbed up the bank to the level part of the path. All its movements, from the time it was forcibly parted from the ball, had the appearance of being dictated by intelligence and reason.

Again, a solitary beetle rolling a comparatively new ball had reached a distance of nine or ten inches from the heap when a second unoccupied beetle coming from the opposite direction stood up in front of the rolling ball as if with the intention of pulling it forward and assisting the first. Instead of doing so, however, it brought the ball to a dead stop. In vain the first beetle tried to move the ball; the second held it fast. The first then got down and peered round the side of the ball, apparently with the object of ascertaining the nature of the obstacle. While this examination was proceeding, the second, with its fore-feet still resting on the upper part of the ball, neither pushed nor moved in any way. The first then stood up again behind the ball and pushed it as before, but still the ball did not move. For the second time the beetle got down, made an examination as before, then, crouching with its back well under the lower curve of the ball, heaved with all its might—in the same way as a workman does in similar circumstances—but the ball remained stationary. The first beetle then came out from under the ball, and was proceeding round its right-hand side, with some new intention, when the two seemed to catch sight of each other. The second beetle threw itself on the ground with the quickness of thought, and fled pursued by the other, both running at their utmost speed. Fear, and a sense of guilt, seemed to spur the flight of the one, resentment and anger the pursuit of the other. In a chase which was continued for a distance of six inches, the fleeing beetle, which had started with an advantage of about an inch and a half, increased the distance between its pursuer and itself to more than two inches, when the former, seeing the futility of further pursuit, stopped, returned to the ball, and resumed its occupation of rolling it.

The reason why the second beetle stopped the ball, remained absolutely motionless when the other got down to reconnoitre, and ran away when it saw it was discovered is not apparent. Dare we suppose that it was simply amusing itself at the expense of the other? This was the impression left on my mind at the time.

W. GALLOWAY.

[1] Crocisa has been reported from the neotropical region, but the species are probably not correctly referable to that genus.

Result of War affected by Soldier's Stature.

IN your issue of March 1 Major-General Warrand denies that the chance of being shot in war depends, *ceteris paribus*, merely upon the square of the soldier's stature.

He would therefore introduce another factor, the thickness of the body, which presents a target varying in size according to the direction from which the fire comes.

This, however, is unnecessary. The stature alone should be considered, because, for the sake of simplicity, we assume that oblique fire is experienced equally by both armies, and we also assume that all soldiers are of similar build. The assemblage of human targets in each army is therefore proportional in size to the square of the average stature.

JOHN HILL TWIGG.

The Hydro, Ben Rhydding.

WHAT IS WHISKEY?

DURING the last three months readers of the daily Press have from time to time been the recipients of informations concerning the nature of whiskey. Their education must have been somewhat heterogeneous in that what whiskey should or should not be seemed to change each week, in accordance with the witness whose evidence was being reported; perhaps now the so-called whiskey test case is over it will be convenient to place before our readers some of the most important facts brought to light by it.

The borough of Islington began its work in the matter of potable spirits with brandy, and succeeded in practically enforcing for this article of commerce a chemical standard. This standard, as in the case of the one which it has, at any rate for the time, succeeded in establishing for whiskey, is a minimal standard, ***i.e.*** brandy must contain at least a certain proportion of so-called compound ethers, and whiskey must, if the judgment in this case be maintained, at least contain a certain proportion of so-called impurities, viz. substances other than ethylic alcohol and water. Before dismissing from our notice the brandy standard, we would emphasise the fact that in the case of brandy a minimal amount of one class of by-product, the individual members of which almost certainly have the same therapeutic effect, is demanded. In the case of whiskey, the Islington magistrate fixed a chemical standard based upon an analytical, not chemical or even therapeutical, entity containing such different substances as compound ethers, higher alcohols, acids, and aldehydes. He further strictly enjoined the kind of apparatus in which whiskey must be produced, and the materials which shall in the two countries producing whiskey be solely used in the mash from which the spirit is to be distilled. The question of a chemical standard for brandy, and the protection which such a standard affords to the public, was thoroughly discussed in NATURE of November 3, 1904. The anomaly of having a fixed minimum and no fixed maximum for alcoholic impurities in potable spirits is too palpable to need amplification, and has been definitely recognised by the Belgian authorities, who refuse to allow the sale of a potable spirit possessing a coefficient of impurities of more than 300. This fact is of special interest at the present time, for if the Islington judgment is to stand, no potable spirit can be sold as whiskey which, *inter alia*, possesses a coefficient of impurities of less than 380.

To the average reader the judgment containing the definition of what for the future must be sold as Irish and Scotch whiskey would read, and it consists of some five thousand words, as if this question had never been considered before; and, indeed, a leading article upon this subject which appeared in a medical contemporary last week contained the extraordinary statement that "five years ago there was no suggestion even that potable spirits might be brought within the operation of the Sale of Food and Drugs Act, with a view to the detection of foreign or added spirit." It can scarcely be news to the readers of NATURE that a Select Committee under the chairmanship of Lord Playfair was appointed in 1891 to inquire into precisely the same question as was laid before the Islington magistrate, and had at its disposal practically the same material; it examined numerous witnesses, chemical, physiological, and commercial, and reported in 1891.

The best way of criticising Mr. Fordham's judgment is to summarise carefully the conclusions of this committee. At the onset it is a relief to find that upon one point at least they agree, viz. that according to both there is no evidence that any potable spirit sold in the United Kingdom as whiskey contains constituents other than ethylic alcohol which are injurious to health; in other respects we are afraid the Islington magistrate in his judgment is diametrically opposed to the report of this committee. Perhaps the shortest way of dealing with this report in the present article is to quote verbatim the Committee's view with regard to the definition of whiskey.

"Your committee do not attempt a legal definition of whiskey. Whiskey is certainly a spirit consisting of alcohol and water, with a small quantity of bye-products coming from malt or grain, which give to it a peculiar taste and aroma. It may be diluted with a certain quantity of water without ceasing to be whiskey, and it may be diluted with spirits containing little of the bye-products to suit the pocket and palate of customers, and it still goes by the popular name of whiskey. Your committee are unable to restrict the use of the name as long as the spirits added are pure and contain no noxious ingredients." Then again :—"There are varieties in the purity of patent or silent spirits. When they are made for blending it is the object of the distiller to retain a percentage of bye-products, though to a smaller extent than in pot-still whiskey."

We cannot think that the Islington magistrate was not aware of these conclusions, although it is exceedingly odd that in so lengthy a judgment no mention is made of the report of the select committee. However, the Islington dicta with regard to whiskey are certainly clear. Irish and Scotch whiskey must be produced by the distillation in a pot-still of the wort derived from a mash consisting in Ireland of 75 per cent. barley malt and 25 per cent. indigenous grain, in Scotland of barley malt alone. We are not told what kind of pot-still is to be used, although it is quite clear to anybody who has studied the subject that, with regard to the degree of rectification capable of being produced, pot-stills differ *inter se* as much as the patent-still differs from the pot. Whether or not the chemical standard of the Islington analyst is also to be maintained is not quite clear, but if so it appears that at least some of the pure malt pot distilleries will have to modify their technique. So far as concerns the actual term whiskey itself, it is not stated definitely that this term, provided it be not prefixed by the epithet Scotch or Irish, should be refused to blended whiskies, that is, to whiskies consisting in some part of patent-still or grain spirit, provided they consist of "a very considerable proportion" of pot-still whiskey. If these blended whiskies are to conform to the chemical standard laid down by the Islington analyst, practically all the blended whiskey on the market at the present day will have to undergo a considerable alteration. It is to be noted that, as distinct from the report of the Select Committee, no

importance is attached by the Islington magistrate to the question of taste or flavour, and no limit is placed by him upon the amount of chemical impurities which whiskey may contain. Although there is scanty reason to believe that the higher alcohols, furfural, and compound ethers in the proportion in which they exist in pot-still whiskey as ordinarily consumed are injurious to health, yet, nevertheless, one cannot view with complaisance a legal definition of whiskey which allows the quantities of these substances to be unlimited. The only safeguard which the public will have will be their own taste. They have shown distinctly what they like in that nine-tenths of the whiskey consumed to-day consists of a blend, with more or less pot-still whiskey, of this same patent-still whiskey, which is to be whiskey no longer, because technologically, if not chemically and dietetically, it diverges too widely from the mediæval and sentimental "usquebaugh."

Two further points in the judgment of the Islington police magistrate will be of interest to technologists; the first is the absolute condemnation of maize as a constituent of the mash from which whiskey is to be made. This is especially interesting because to those cognisant of the literature of the subject this question of maize as a constituent of brewing and distilling mashes is by no means a new one. Although precedent seems to be no justification at Islington, it is a fact that maize was used as a constituent of distilling mashes previous to 1881. We choose this date advisedly, because in 1881 the use of this same opprobrious maize as a constituent of brewing mashes was by the Free Mash Tun Act actually legalised. Again, the Select Committee on bonded spirits was fully cognisant of the use of maize in distilling mashes, and in its report of 1891 had nothing to say against this grain. Still further, in 1898 the Beer Materials Committee, after a most exhaustive inquiry, refused to prohibit the use of maize. Lastly, the American Pharmacopœia, which includes whiskey as an official preparation of alcohol, specifically states that it may be made from maize. So far as we can gather, the objection to maize is that it cannot be, or at any rate is not, ripened in this country.

The last point which we have space to consider is the statement that, apart from taste and flavour, patent-still whiskey has a different effect upon the consumer from pot-still whiskey. It is true that the therapeutic evidence at present at our command upon this subject is somewhat scanty, but what there is points to the conclusion that practically the only active constituent in whiskey is ethylic alcohol, and that if a given dose of whiskey differs otherwise than in taste and flavour from a proportional amount of pure ethylic alcohol equally diluted, this difference is due entirely to the presence of certain compound ethers. Now as a matter of fact, although patent-still whiskey contains a smaller coefficient of impurities than pure pot-still whiskey, the ethereal moiety of the impurities is approximately the same in both. At any rate, the amount of compound ethers taken in an ordinary dose of patent-still or blended whiskey so nearly approximates to that taken in any ordinary dose of pot-still whiskey that no therapeutical difference is, *a priori*, to be expected between the two beverages as consumed. The direct evidence we have upon this subject bears out this *a priori* reasoning.

Over and above the details which have been brought to light in these whiskey prosecutions, everyone must be struck by the curiousness of a legislation which allows disputes of this kind to be decided in a police court. During the past few years many special committees have sat upon subjects relating to the working of the Sale of Food and Drugs Act, and not a few of them have specifically recommended either the institution of a permanent court of reference for these matters or at any rate that they should be laid before some specially organised tribunal. It is sincerely to be hoped that before long these recommendations may be adopted.

THE ROYAL COLLEGE OF SCIENCE.

THE relation between the University of London and the proposed new Royal College of Science has been the subject of some discussion since the publication of the report of the departmental committee on the college, described in our issue of February 8 (p. 344). It is devoutly to be hoped, however, that the consideration of this matter will not divert attention from the essential point of the committee's report, namely, "that it is desirable that the new institution should be established immediately, and that its organisation should proceed without delay." Divergent views may be held as to the nature of the connection between the University and the new College, but there can be no two opinions as to the folly of delaying the establishment of the institute, as recommended by the committee, while questions of control are being decided.

The subjoined letter from Mr. C. McDermid, hon. secretary to the British Science Guild, appeared in yesterday's *Times*, and the plea of urgency contained in it is endorsed in a leading article in the same issue.

I am directed by the executive committee of the British Science Guild to request you to be good enough to give publicity to the following expression of the views of the committee on a matter of great national importance.

The departmental committee on the Royal College of Science has shown in its final report that a start can at once be made to provide for the most advanced instruction and research in several branches of applied science, which all are agreed are imperatively necessary in the interests of our national industrial progress.

The danger of delay in giving effect to the recommendations of the departmental committee is recognised by the leaders in science and industry, who are largely represented among the members of the British Science Guild.

The Government have signified their willingness to hand over to a new governing body the present buildings of the Royal College of Science and Royal School of Mines, the new chemical and physical laboratories, which are approaching completion, and some adjacent acres of land on which to erect new buildings. In addition to this it is understood that the Commissioners of the 1851 Exhibition will provide an additional building site, and that the council of the City and Guilds of London Institute will cooperate in the scheme.

The Government are prepared to provide a yearly grant about equal to the interest at $2\frac{1}{2}$ per cent. on one million pounds sterling, and there is reason to hope that the London County Council will vote an approximately equivalent sum. In addition to this there is the munificent gift of 100,000*l*. from Messrs. Wernher, Beit, and Co., and the sum that it is expected will be provided for the equipment of the new mining and metallurgical laboratories as the central object of a national memorial to the late Sir Henry Bessemer.

In view of all these most favourable conditions the executive committee of the Guild earnestly hope that neither the question of the ultimate and final relationship of the new institution to the London University nor any other matter will be allowed to interfere with the immediate appointment of at least an organising governing body. This body might deal *inter alia* with the status and qualifications of the professional staff required and obtain detailed expert advice with regard to the new buildings to be erected.

Probably no more propitious time for founding a college of the kind contemplated could be offered

than the present. The Perkin jubilee has been the means of arousing a certain amount of interest as to the cause of lost industries, and the remedies to be applied if we are to secure industrial progress in the future. Enlightened manufacturers are prepared to give substantial support to an institution which will aim at bringing scientific knowledge in close relation with industries and industrial needs. Not to take advantage of the present desire for action would be dilatory policy; and if the scheme is held up while discussion takes place upon its academic aims and relationships, nothing could be more disappointing to those who are anxious to see the establishment of an institute capable of rendering great service to the community.

In the proposed new college no provision is to be made for biological subjects; and Prof. Ray Lankester has written a letter to Lord Rayleigh, president of the Royal Society, pleading for the recognition of the fact that the needs and the importance of these sciences are as great or greater, and that they are at present well-nigh destitute of any endowment, or of adequate provision at the public charge of laboratories and the means of research. Prof. Lankester shows that there are many branches of applied biology of importance to the State, and though he does not propose any formal action to the council of the Royal Society he trusts "that means may be devised of obtaining an assurance from the Government of not merely continued, but increased, provision for the highest work and training in the various sciences of the biological group—including geology."

PROF. SAMUEL PIERPONT LANGLEY.

AT the zenith of his reputation, and possessed of his full capacity for work, America and science have to regret the death of Prof. Langley, who for nearly twenty years directed and controlled the energies of the Smithsonian Institution. The objects promoted by such an establishment are so varied, the interests that it has to maintain are so numerous, that its direction can only be confidently entrusted to one who combines the skill of the administrator with the training of the man of science. The energy displayed by Prof. Langley in the conduct of the Smithsonian Institution, and its steadily increasing influence under his direction, show that he loyally appreciated the intentions of the founder, and that he proved himself a worthy successor to Joseph Henry and Spencer Baird, names still warmly treasured in the memory of the American nation. We may recall, though we cannot do justice to, some of the more important features that have marked his connection with the institution. His supervision of the museum, and his earnest endeavour to make it more valuable for instructed and uninstructed alike, led to rearrangement, and especially to the foundation of the children's room, a feature which may serve as a model for similar institutions. The Bureau of American Ethnology is a national undertaking that has long been conducted on spacious lines, but under the late director this department has assumed magnificent proportions, the care of which was an enormous responsibility that even the assistance of able colleagues could not wholly remove. The publications of this bureau show only the thoroughly digested scientific conclusions, and represent but a fragment of the immense amount of work actually accomplished. But, perhaps, in the establishment and management of the zoological park we see the personal influence of the director most conspicuously exhibited. It was his dream to establish a park in which the wild animals of his native land might live as nearly as possible under conditions natural to them, so that they might breed and thrive in captivity as in their native haunts. The difficulties in the way might well have daunted one less enthusiastic. More than once the question of abolishing the park has been considered, and over and over again he had to fight the battle in the teeth of hostile or indifferent politicians, who could not be made to appreciate the value of the scheme, or to recognise that the preservation of the native animals, threatened with extinction, was a trust committed to their charge. He lived to see this scheme placed on a permanent footing, and if on a more modest scale than he could have wished, he could feel that his insistence had not only preserved the nation's heritage of wild animals, but had opened up important regions of biological research and of zoological art.

But, notwithstanding the severe demands the care of such an establishment must make, Prof. Langley did not allow his activity to be wholly absorbed in the interests of the Institution. He never forgot that he was a physicist and an astronomer before he became an administrator. As a physicist, the problem of flight largely engaged his attention, a subject to the consideration of which he was led by his studies on the internal force of the wind. To what extent his experiments advanced the problem of aviation it would be premature to pronounce. The form of aërodrome which he favoured was capable of making flights of a mile, unsupported except by the mechanical effects of steam engines. But these successful flights were carried out on models. The application of the same principle to larger machines was, as he contended, never fairly tried. The launching apparatus was ineffective, and his machine never got into the air at all. But if its capacity for sustained flight was never tested, some of the mechanical features that he tried and adopted will no doubt find their place in later constructions. As an astronomer he will be remembered for his direction of the Allegheny Observatory and the important work which he accomplished there on the sun and in the department of spectroscopy. His drawings of the solar surface, made nearly forty years ago, remain unsurpassed for delicacy and truthfulness, while his views on the physical constitution of the sun are worthy of the closest attention. As an experienced observer of solar eclipses he was also well known, and thirty-five years ago, when the spectroscopic examination of the sun's surroundings had made but little advance, he rendered yeoman service. The invention of the bolometer constitutes a distinct claim on our gratitude. This sensitive instrument affords the means of measuring minute changes in heat arising from the change in the electrical resistance of an extremely thin strip of metal. By its use Prof. Langley showed that the corrections for atmospheric absorption, deduced by earlier observers with less perfect instruments, are all too small, and consequently the generally received value of the "solar constant" has been considerably increased. With the same instrument our knowledge of the infrared spectrum has been greatly increased. The heating effects from rays unsuspected in previous investigations have doubled the known extent of the solar spectrum. By the aid of rock-salt lenses and prisms Prof. Langley was able to show that bands of atmospheric absorption were found to alternate with bands of solar radiation, a fact of no inconsiderable importance in terrestrial meteorology.

As a writer the late director of the Smithsonian Institution was well known for his powers of graphic description and vivacious style. His "New Astronomy," published many years ago, attracted very

considerable attention, and did much to popularise the science in America. It is needless to say that he was a member of many learned societies, American and European; it will be sufficient to refer here to the fact that he was elected a foreign member of the Royal Society in 1895. At the age of seventy-two he is removed from that position he was so well fitted to adorn, and the respectful sympathy of the men of science of all nations will be offered to those who suffer by his loss.

W. E. P.

NOTES.

ONE good purpose served by the movement referred to last week (p. 419) to commemorate the jubilee of the discovery of the first artificial coal-tar colour by Dr. Perkin is that public attention has been directed to the relations between scientific research and industrial progress. The complete lack of sympathy between the capitalist in this country and the scientific worker, largely due to the indifference shown by statesmen to scientific studies, has been persistently deplored in these columns for many years; and we are glad that the general public is now being enlightened as to the results of neglect of scientific research. The coal-tar industries, founded upon an essentially British discovery, have been lost to us, and are now represented in Germany by two industrial groups which, with a capital of 50,000,000*l.*, can pay dividends of from 20 per cent. to 30 per cent. per annum. Prof. S. P. Thompson, in a letter to Saturday's *Times*, refers to this lost industry, and shows that the electrical industry and the manufacture of steel must pass to other countries unless our manufacturers realise the industrial value of higher technical education and scientific research. "Pioneering," he remarks, "as it is understood in an electrical factory in the United States or in Germany, is now almost non-existent in England; and the result on the electrical industry in the next ten years must be simply disastrous. Where are the newer kinds of electric lamps being developed? The Nernst lamp, the flame lamp, the vapour lamp, the oxide lamp, the osmium lamp, the tantalum lamp, all rich in future possibilities, where are they being perfected? Not in England. I doubt if there is a single British firm that is spending on such development a tenth part of the sum that one single American firm is spending on this one thing alone. If we cease to pioneer we become mere followers at a distance of those who are going forward—ourselves cease to lead in the development of the industry." To save our country from future disaster, our commercial and educational leaders, and our statesmen, must realise the vital nature of scientific research to national prosperity, and act upon this conviction by making adequate provision for it.

THE town council of Hamburg has voted the sum of 586,000 marks (29,300*l.*) for the construction of a new observatory at Bergedorf, about ten miles from Hamburg, and 309,000 marks (15,450*l.*) for the instrumental and electrical equipment of the observatory.

PROF. W. OSLER, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

THE American Geographical Society has awarded Captain R. F. Scott its gold medal in recognition of his services as commander of the British Antarctic Expedition. The Paris Geographical Society has awarded one of its gold medals to Major C. H. D. Ryder in recognition of his work as surveyor and explorer in connection with the recent Tibet mission, and his expedition to the sources of the Brahmaputra.

THE Berlin correspondent of the *Times* states that on Monday the German Emperor formally opened the new Museum for Marine Science, Berlin University. Among those present at the opening ceremony were the Prince of Monaco, the Rector of the University, Geheimrath Diel, and many distinguished representatives of natural science. The institute, which owes its existence to the direct initiative of the German Emperor, is intended to promote and encourage the interest of the German people in marine matters, and to place the subject upon a scientific basis.

THE Empress Frederick Institute for the higher scientific and practical education of medical men, which owes its inception to a project initiated by the late Empress Frederick, was opened in Berlin on March 1. The German Emperor and Empress, accompanied by many members of the Prussian Royal Family, were present. Sir Felix Semon attended the ceremony in accordance with the commands of King Edward, and in the course of a short address referred to the King's personal interest in the new institution.

A ROYAL COMMISSION has been appointed to inquire into the canals and inland navigations of the United Kingdom, and to report on their present condition, financial position, the facilities, improvements, and extensions required to complete a system of through communication by water, the expediency of canals being made or acquired by public bodies, and other matters related to these subjects.

SIR EDWARD FRY will preside at the twenty-third annual congress of the Royal Sanitary Institute, which will be held at Bristol from July 9 to 14. The presidents of the various sections will be:—Section i., sanitary science and preventive medicine, Sir William J. Collins, M.P.; section ii., engineering and architecture, Mr. Edwin T. Hall; section iii., physics, chemistry, and biology, Dr. W. N. Shaw, F.R.S.

AT the third International Seismological Conference, held at Berlin on August 15, 1905, Signor Luigi Palazzo was elected vice-president of the permanent board of the International Seismological Association. As Prof. A. Schuster was unable to accept the presidency offered him, the assembly deputed Signor Palazzo to act as president until the new elections take place next summer. Signor Palazzo desires it to be known that the Italian Government has consented to his acceptance of the office and responsibility, and he asks for the support of all who take an interest in the progress of seismology.

DR. C. W. ANDREWS, of the British Museum, left England last week to resume the quest for the remains of extinct vertebrates from the Tertiary deposits of the Fayûm and other parts of Egypt. Recent discoveries in Egypt have demonstrated the descent of the Eocene zeuglodonts from creodont Carnivora, and it is one of the objects of the present expedition to endeavour to discover, in higher beds, the missing links between zeuglodonts and true cetaceans. It may be added that the present expedition (like the earlier ones) of Dr. Andrews has been rendered practicable by the generosity of Mr. W. E. de Winton.

Science reports that, according to a despatch to the daily papers from Washington, the Carnegie Institution has purchased a tract of six acres in the north-west section of Washington, near Rock Creek Park, where it will erect a permanent home. The site is near the building of the

United States Bureau of Standards, and is in a commanding position, overlooking the entire city. The purchase price was 700*l.* an acre, and a building to cost 20,000*l.* will be erected at once.

THE great horticultural exhibition, to be held in the gardens of the Royal Botanic Society on Wednesday, June 13, will be opened by Princess Alexander of Teck.

THE Badische Anilin- und Soda-Fabrik, of Ludwigshafen, proposes to lay down a hydraulic power plant for the preparation of nitric acid from atmospheric nitrogen by the Birkeland process. Instead, however, of preparing calcium and sodium nitrate for artificial manures, as in the Norwegian installations, it is intended, in the first place at least, to make potassium nitrate for explosive purposes.

ACCORDING to the *Chemiker Zeitung*, the proposed new offshoot of the General Electrical Company, Berlin (p. 421), for the manufacture of mercury lamps in Europe is to be known as the "Quarzlampengesellschaft." The great advantage of the lamps will be the possibility of preparing them for all voltages up to 500 volts, and, in addition to the fact that no carbons are required, the lamps should be usable for 1000 hours without attention; it is expected that the lamps will in many cases replace arc-lamps.

AT the meeting in the Aula of the Berlin University on February 21, which was held at the invitation of the preliminary committee appointed last year to investigate the question of the formation of a Chemische Reichsanstalt, there were present some 150 of the most eminent representatives of German academic and industrial chemists, as well as several representatives of the Prussian Board of Education. After a few remarks by the president, Prof. Emil Fischer, the report of the preliminary committee was presented by Prof. Nernst. The great majority of the scientific and industrial societies consulted were decidedly in favour of such an institution; sympathetic answers were also received from most of the different German States and from the Imperial Government offices. Prof. Ostwald, who referred to the experiences gained during his recent stay in America, spoke of the necessity of the proposed institute from a scientific point of view, while Prof. Duisberg spoke from the technical side. After further discussion, the meeting unanimously agreed to the plans submitted by the preliminary committee, and moved that the Imperial Treasurer be approached on the subject. It is proposed that the institution be placed either in Berlin or in one of the suburbs; further particulars and details of the proposed scheme will be given in a subsequent issue.

A REUTER message from Rome states that the convention for the establishment of an International Institute of Agriculture has been signed by Italy, Russia, Servia, Belgium, San Salvador, Portugal, Mexico, Luxemburg, Switzerland, Persia, Japan, Ecuador, Bulgaria, Spain, France, Denmark, Greece, Sweden, Holland, Uruguay, Germany, Nicaragua, Austria-Hungary, Great Britain, Egypt, the United States, and Cuba. Other Powers have notified their intention of signing the convention. The creation of the International Institute of Agriculture is therefore assured, and it will be able to begin its labours next year. King Victor Emmanuel has determined that the palace of the institute shall be completely finished by 1907. His Majesty has presented the funds necessary for this enterprise, and the work will be started very shortly.

THE twenty-eighth annual general meeting of the Institute of Chemistry of Great Britain and Ireland was held on March 1, Mr. David Howard, the retiring president, in the chair. In his address, Mr. Howard referred, among other matters, to the great advances in chemistry that had been due to the work of private practitioners, giving his opinion that any action which tends to interfere with the individual practitioners would be fatal to progress. With greater facilities for training, and, consequently, a larger supply of chemists, it was evident that only the most efficient could hope to be successful. In conclusion, Mr. Howard referred to the new president, Prof. Percy F. Frankland, F.R.S., who had long been associated with the institute, and whose father, Sir Edward Frankland, was the founder and first president of the institute.

THE annual meeting of the Liverpool School of Tropical Medicine, which was held last week in the Liverpool Town Hall, under the presidency of the Lord Mayor (Alderman J. Ball), was attended by a large number of prominent citizens, including Sir Alfred Jones (chairman of the school), Mr. William Adamson (vice-chairman of the school), Prof. Carter, Prof. Ronald Ross, C.B., Dr. Caton, Mr. Charles Booth, jun., and Mr. Philip Davey. Princess Christian wrote expressing her constant warm personal interest in the progress of the school, and sympathetic messages were received from other prominent persons. The report shows that excellent work is being done by the school. The committee acknowledges the continued generous support of the public, but further funds are needed in view of the great development of research work. A sympathetic reference was made to the regretted death of Dr. J. E. Dutton, who lost his life while engaged in the investigation of trypanosomiasis and tick fever on the Congo.

AN agricultural conference was held in Bombay on February 5 and following days. In opening the meetings, Mr. Muir MacKenzie, the president, said that important beginnings had been made in the department of agricultural research and education. It was the late Mr. Ozanne who gave the first effective impetus to the scientific development of agriculture in the west of India. He established the Kirkee demonstration farm and dairy. This dairy has developed into an industry which has spread all over India. Referring to the agricultural colleges, the president said that by a course of study at the colleges it was not expected to make a man into a scientific and practical farmer. The colleges give an agricultural bent to the student's mind, and enable him to think correctly about agriculture and to bring to bear upon agricultural problems in India the information thus acquired. Referring to the experiments with Egyptian cotton made in Sind, he said this year the crop was estimated at 1200 bales, and next year 4000 bales were expected. They were justified, he continued, in entertaining some confidence that the establishment of that valuable product in Sind would be an accomplished fact, and would prove a substantial addition to the agricultural resources of the country.

Naturen for February contains an article by Prof. G. Guldberg on the pigmies of the Congo forest.

WE have received a copy of a paper by Mr. C. O. Esterly on the nervous system of copepod crustaceans, issued in the Zoological Publications of the University of California.

AMONG the contents of the February *Zoologist* reference may be made to an article by Mr. G. Renshaw on the extinct Mauritius dove, or "pigeon hollandais" (*Alectoraenas nitidissima*). Discovered between 1774 and 1781, it was still common in 1790, but when it was exterminated

cannot be determined. There is a specimen in the Edinburgh Museum of Science and Art, and another at Port Louis.

To the January number of *Spolia Zeylanica* Dr. O. von Linstow contributes a paper on parasitic worms (Helminthes) in the Colombo Museum, while Mr. N. Annandale discusses certain lizards and stalked barnacles in the same collection. Among the lizards, a curiously striped skink, which had been described as *Euprepes hallianus*, is made the type of the new genus Theconyx. In reference to the recent discovery by Dr. Willey that the lemurs of the genus Loris are almost peculiar among Primates in having four mammæ, Mr. Annandale records that the same condition obtains in their allies of the genus Nycticebus.

According to the annual report for 1905, the Royal Zoological Society of Ireland enjoyed an unusually good year, the gate-money having increased by one hundred pounds, while the entrance-fees and subscriptions reached a total which has only once been exceeded, and then only by a few shillings. The balance-sheet has also benefited to a considerable extent by the sale of superfluous animals. Very wisely, the council has spent a considerable portion of this increased income in improving the accommodation provided for the denizens of the gardens, the most important addition being an open-air aviary measuring 90 feet by 50 feet, with a height of 20 feet. Experiments have also been made, with most satisfactory results, in placing tropical animals in the open air, a number of parrots having been introduced into one of the smaller outdoor aviaries, while a party of Indian rhesus monkeys has likewise been kept for some months without any shelter. An excellent coloured plate, forming the frontispiece to the report, shows these monkeys in the snow, apparently in a high state of health and contentment.

Important information with regard to the origin, rise, and decline of British whaling, both in the icy north and in the southern seas, is furnished by Mr. T. Southwell in the February issue of the *Zoologist* at the conclusion of an article on last season's catch of the Dundee whaling fleet. Although Hull and Bristol had for a long time previously been in the habit of sending vessels to Newfoundland and St. Lawrence Bay for seals and walrus, Greenland whaling was initiated from London and Hull in 1610 or 1611. The Dutch opened the route to Davis Strait in 1719, but were not allowed for long to enjoy the whaling by themselves. Scotland commenced Greenland whaling in 1750 from Leith; Dundee, the only British port from which whalers are now dispatched to the north, not joining in until 1790. Sperm-whaling in the South Seas, which appears to have been confined to the port of London, commenced in 1775 and continued until 1853, when it was abandoned to the Americans. During last season more whales were seen in Davis Strait than for some years past, the total catch being twenty-three.

We have to acknowledge the receipt of four parts (Nos. 1434–7) of the Proceedings of the U.S. National Museum, in the first of which Mr. E. A. Klages describes a collection of moths belonging to a certain group from Venezuela. A fossil raccoon from a cave in California, described by Mr. J. W. Gidley, forms the subject of the second. We regret to see that in describing, in the third, certain macaque monkeys from the Malay countries, Mr. G. S. Miller seeks to replace the well known and universally accepted generic name Macacus by Macaca, on the ground that the latter is the earliest form of the name to be found in scientific literature. We stand sorely in need of a statute of limitation in regard to altering and replacing names. In the fourth Dr. L. Stejneger describes a new species of lizard belonging to the group of "horned toads" from Mexico. Whether, however, this species is entitled to be included under the latter title is almost doubtful, seeing that it lacks the horns from which the others take their name. It is also characterised by a peculiar downward expansion of the lower jaw.

From Dr. F. Ameghino, director of the Buenos Aires Museum, we have received copies of two papers from the *Anales* of that institution, one dealing with the remains of fossil penguins from the Tertiary deposits of Seymour Island, in the Antarctic, and the other with the Tertiary edentate mammals of France and Germany. Judging from their metatarsal bones, some of which indicate birds of very large size, the Seymour Island penguins are represented by a large number of species, these being referred by the author to no less than eight generic types, all of which are regarded as distinct. Of wider interest is the paper on the Oligocene and Miocene edentates of Europe, especially since the author's familiarity with American representatives of the group renders him peculiarly well qualified to test the determination of the European fossils. It is satisfactory to learn that Dr. Ameghino is fully convinced that among the latter are included armadillos, aard-varks, and pangolins, some of the armadillos coming very close to South American forms. This assemblage of three groups of edentates in the countries fringing northern Africa is suggestive that the latter continent may have been the original home of the group, which reached South America by direct land-connection.

The Bausch and Lomb Optical Co., of Rochester, New York, the makers of the Minot microtomes, has recently issued a new catalogue of its instruments, in which reference is made to certain improvements in the Minot automatic rotary microtome.

Under the title "Glycogène et Paraglycogène chez les Végétaux," some notes written by the late Prof. L. Errera are published in the *Recueil de l'Institut botanique*, Brussels, vol. i., 1905. The notes refer to microchemical experiments on certain low organisms to test for the presence of these substances.

The Trinidad Bulletin for January contains articles on cocoa diseases observed in Ceylon and the West Indies, and on the use of lime in agriculture. Two new instruments for rubber-tapping are mentioned, the one a revolving pricking instrument, the other an improved V-cutting knife. Reference is also made to the small fish, species of Girardinus, found in Trinidad and Barbados, that feed on the larvæ of mosquitoes; it is suggested that it would be useful to place them in pools in malarial districts.

The first stage in the inquiry as to the possibility of establishing a beet-sugar industry in this country consists in making cultivation trials in the districts where the industry is likely to be located. Under the superintendence of Mr. G. Clarke, of the County Technical Laboratories, Chelmsford, sugar-beets were grown last year on experimental plots on five different farms. The reports from the growers giving cost and yield per acre are printed, together with the chemical analyses, in a pamphlet published by the Essex Education Committee. The cost of cultivation, manures, and of raising the beets averaged rather more than ten guineas per acre; on a large scale probably eighteen to twenty tons of roots could be grown for about

ten pounds per acre, and it is estimated that the farmer would receive from seventeen to twenty shillings per ton of trimmed roots delivered at the factory.

In a paper read before the Royal Geographical Society on January 29 Prof. G. F. Scott Elliot gave an account of his observations on the various plants that aid in the formation of alluvial flats in the valleys of such rivers as the Aconcagua, in Chile, and the La Plata. The composite shrub, *Baccharis marginalis*, protected from drought by gum-containing leaves, was found to be one of the first settlers to fix the banks on the Aconcagua, after which other plants, including poplars and willows, could secure a hold, and gradually a river-side wood might be formed; or in the deeper backwaters plants of the nature of *Scirpus americanus* or *Juncus dombeyanus*, and in the shallows species of Eleocharis, spread out their horizontally creeping stems and upright stalks holding the mud and catching the drift until, in the marshy condition, grasses could grow over and fill up the swamp.

An experimental station for the study of sugar-cane cultivation and of the diseases of the sugar-cane was opened at Samalkot by the Madras Government in 1902. Mr. C. A. Barber presents a report of the work for the year 1903–4 in Bulletin No. 51 of the Department of Land Records and Agriculture, Madras. Two local varieties, Bonta and Yerra, and an introduced cane, Red Mauritius, were selected for special experiment; the Bonta was eaten out by jackals, the Yerra did not suffer much and gave good results, but the Red Mauritius produced the greatest weight of cane and the largest amount of jaggery. The practice of wrapping the canes that is usual in the Godávari district will form the subject of experiment; the older leaves are twisted and wrapped round bamboos fixed in the ground; the object is two-fold, the leaves serving as a protection against jackals, and the bamboo supports preventing the canes being blown down in cyclonic storms.

A tornado of considerable violence occurred at Meridian, in the State of Mississippi, on the evening of March 2, involving much loss of life and causing great destruction of property. The tornado is said to have travelled at the rate of seventy-seven miles an hour, and to have passed away in two minutes. It apparently travelled from south-west to north-east, and in its progress it is reported to have ploughed a path 600 feet wide and one mile long.

A severe hurricane occurred in the South Pacific on February 7 and 8, and was attended by very serious loss of life and property. According to the report received in this country from San Francisco, received there through the steamship *Mariposa*, damage to the value of 200,000*l*. was wrought in Tahiti, and it is believed that similar damage was caused in the Tuamotu Islands. The loss of life is rumoured as numbering several thousands. Papiete, situate on the north side of Tahiti, is said to have been inundated, and it would appear that the hurricane was accompanied by a series of high waves. The storm is reported to have struck the islands with a wind velocity of 120 miles an hour at midnight on February 7, and to have continued until four o'clock on the following afternoon. In this part of the world storms usually travel from the north-westward. According to the Admiralty sailing directions for the Pacific Islands, the hot months, December to March, are those in which storms may be expected, and clearly they are of fairly common occurrence in the Society Islands and in the Tuamotu Archipelago, but as a rule the hurricanes do not appear to be so severe as those of the Atlantic and Indian Oceans or of the China Seas. At present the information to hand with respect to the recent storm is very meagre, and further details will be anxiously looked for.

Japan has gained her supremacy in the East by a careful and minute study of the methods of the West. It is now the turn of the West to look towards the East for enlightenment, and we do not look in vain. Weather is an important item in commercial prosperity, and the study of it is therefore of the highest importance to every nation. If a country is subject to devastating cyclones, it is of the utmost necessity that inquiry should be set on foot to try to solve the causes of their frequency, and forecast, if possible, their advent, in order to mitigate so far as possible the damaging results which will eventually ensue. One old British possession, a valuable asset to the British Empire, is occasionally visited by these destructive air movements, and instead of concentrating a meteorological attack by erecting a first-class station, the British Government reduces the already microscopic annual grant of 100*l*. to 50*l*. In Japan science is respected, and respected probably because that country knows that scientific method is at the base of progress. In meteorological matters Japan does not mean to be left behind, and as the first duty of a German colonist seems to be to set up a barometer and thermometer and read them, so Japan follows suit by organising a meteorological service in Korea and Manchuria. An article upon this service, and the first-class observatory at Chemulpo, appeared in the *U.S. Monthly Weather Review* for September, 1905, and has already been noticed in these columns (February 15, p. 374).

A conspicuous and valuable feature of recent numbers of the Proceedings of the Tokyo Physico-mathematical Society is the number of short papers containing simple applications of deductive reasoning to physical phenomena. Thus we have an extension of Gibbs's phase rule to systems in which the potential differences between the phases enter into the equations, by Shizuwo Sano (ii., 25); a theory of the rainbow due to a circular source of light, by K. Aichi and T. Tanakadate (ii., 27); a discussion of the whistle produced by the vibration of a liquid drop, by T. Terada (ii., 26); and an explanation of the existence of secondary vibrations in seismic waves, by H. Nagaoka (ii., 28), based on the supposition that the acceleration due to the elastic force of the rock contains terms proportional to powers of the displacement higher than the first.

"A Problem in Analytic Geometry with a Moral" is the somewhat attractive title of a paper by Prof. Maxime Bôcher in the *Annals of Mathematics*, vii., 1. The problem, which is quite elementary, consists in the determination of all the families of conics which cut a given conic, say $x^2 - y^2 = 1$, at right angles. Taking the intersecting conic as given by the general equation of the second degree, the method of solution is to find the locus of the points the polars of which with respect to the two conics are at right angles, and to make this locus pass through the intersection of the two conics. At this stage the author advises the reader to complete the solution himself before reading further; if he does so, there is considerable probability that he will fail to obtain all the four solutions. The reason of this is that there is one family of orthogonal conics such that the polars of *any* point with respect to one of these conics and the original conic are at right angles, so that the coefficients in the equation of this locus vanish identically. The interesting point is that these conditions determine, not a single curve, but a family of curves with the same degree of generality as the families determined by the other conditions.

A NUMBER of papers on aërial navigation have appeared comparatively recently. Of Captain Ferber's work on stability of aëroplanes mention has been already made (p. 350), and it may be sufficient to add that in this particular connection, contrary to the old adage, "an ounce of theory is worth a pound of practice." But the same writer has since sent us a reprint of papers in the *Revue d'Artillerie* for August last, now published by Berger-Levrault, of Paris, under the title "Pas à Pas, Saut à Saut, Vol à Vol," which, to emulate the author's style, constitutes a comprehensive *vol au vent* of experimental gliding up to date, illustrated by many figures. Turning a little further back to the *Revue scientifique* (5, iii., 24, 25), we find an interesting discussion by M. Bazin of the source of energy in sailing flight of birds. The theory is essentially identical with that brought into prominence by Langley's work, in which variations in wind-velocity account for the phenomenon; but the author has also shown how models can be constructed in which this explanation is illustrated by the motion of a marble rolling on a movable kind of switchback. More recently, in the *Revue générale des Sciences* (xvi., 21), M. M. Léger details his attempts at obtaining the necessary lifting force in a machine of the "plus lourd" type by a combination of "helicopters" (vertical screws) and aëroplanes; his experiments have been carried out with the assistance of the Prince of Monaco. A little further back in the same series Lieut.-Colonel G. Espitallier discusses the materials and construction of balloons. Prof. S. P. Langley's work is described in a pamphlet, reprinted from the Smithsonian report by the Washington Government. A paper has also reached us from Madrid detailing the formation of a Royal Aéreo-Club of Spain. The current numbers of the *Aëronautical Journal* contain too much matter to be summarised here. Attention should, however, be directed to the flying model competition organised by the Aëronautical Society for July of this year.

A COPY of the twenty-sixth volume of the Proceedings of the Dorset Natural History and Antiquarian Field Club has been received. The volume has been edited by Mr. W. Miles Barnes. It contains the presidential address of Mr. Nelson M. Richardson, and, in addition to other contributions, papers by the Rev. O. Pickard-Cambridge, F.R.S., on new and rare British Arachnida; the Rev. E. F. Linton, on Dorset plants; Mr. H. Stillwell, on the returns of rainfall in Dorset; the Rev. H. S. Solly, on the landslip at Lyme Regis; Mr. W. B. Barrett, on the flora of the Chesil Bank and the Fleet; and the president, on first appearances in 1904 of birds, insects, and first flowering plants in Dorset.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET, 1906*b*.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Herr Kopff at the Königstuhl Observatory on March 3.

At 14h. 52·8m. (Königstuhl M.T.) on the day of discovery the position of the comet was

R.A. = 11h. 35m. 56s., dec. = + 1° 40′,

and the following values were determined for the daily movement:—in R.A. −7′ (−28s.), in dec. +4′.

A second telegram from Kiel announces that Dr. Valentiner, observing at the Königstuhl Observatory, Heidelberg, on March 4, recorded the position of this object as

R.A. = 11h. 35m. 35·8s., dec. + 1° 40′ 37″

at 10h. 13·4m. (Königstuhl M.T.).

Thus it will be seen that the comet is in the southern part of the constellation Leo, and was about half-way between ν Leonis and β Virginis when discovered. It is travelling very slowly in a W.N.W. direction, and is on the meridian about midnight. No intimation of its magnitude has, as yet, been received.

THE RING NEBULA IN LYRA.—In 1902 Dr. Newkirk showed, in his inaugural dissertation for the doctor's degree at Munich, that the central star in the annular nebula in Lyra had a proper motion, and, from the value he obtained for this movement, he deduced the parallax of the nebula, finding it to be 0″·10.

As this was the first nebula for which any proper motion and parallax had been deduced, the verification of Dr. Newkirk's results became a matter of great importance, and therefore Prof. E. E. Barnard has made several measurements, photographic and visual, with the 40-inch refractor at Yerkes Observatory.

The results obtained do not verify those of Dr. Newkirk. According to the latter the total displacement of the nucleus during the five years which elapsed between Prof. Barnard's observations in 1898–9 and those of 1903–4 would have amounted to 0″·90, an easily measurable quantity, but no displacement at all could be detected.

As Dr. Newkirk's parallax for the central star depended upon his value for the proper motion, it must now, according to Prof. Barnard's results, be rejected as fallacious.

The latter observer concludes from his observations that everything in the immediate region of this nebula seems to have the usual fixity of the ordinary small stars (Monthly Notices R.A.S., vol. lxvi., No. 3).

A CLUSTER OF NEBULÆ IN PERSEUS.—In No. 4069 of the *Astronomische Nachrichten* Dr. Max Wolf describes his discovery of a number of small nebulæ in the regions about β and Nova Persei. These objects were seen, and their positions measured, on photographs obtained with the Bruce telescope, and they mostly lie in two bands, for which Prof. Wolf gives the positions.

The nebulæ are especially dense where these two bands coalesce, a region of 12′ (of arc) square containing 148 of them. Their forms are generally recorded as "round, with central condensation," and "form of Andromeda nebula."

TWENTY-FIVE NEW VARIABLE STARS.—Circular No. 107 of the Harvard College Observatory contains the positions and magnitudes of twenty-five variable stars recently discovered by Miss Leavitt from the examination of six plates taken with the 24-inch Bruce telescope.

The plates are of fine quality, and probably show altogether some 200,000 star images. The twenty-five variables contained in the list lie in the constellations Orion, Virgo, and Cygnus, and two of them in the last named constellation have magnitude ranges of 3·5 and 3·0 respectively.

THE GLOW SURROUNDING THE LUNAR CRATER LINNÉ.—Some interesting results of observations of Linné are published by Prof. E. E. Barnard in No. 4075 of the *Astronomische Nachrichten*.

The glow surrounding the crater was measured, on various dates between December, 1902, and November, 1904, with a micrometer attached to the 40-inch refractor at Yerkes, and Prof. Barnard concludes that its diameter does vary with the moon's age. The following table represents the curve, obtained from the observational results, for the varying diameters:—

Moon's age d. h.	Diam. of glow ″	Moon's age d. h.	Diam. of glow ″
7 0	6·6	14 0	3·4
8 0	6·0	15 0	3·3
9 0	5·4	16 0	3·3
10 0	4·8	17 0	3·4
11 0	4·3	18 0	3·5
12 0	4·0	19 0	3·8
13 0	3·7		

The diameters have been reduced to the moon's distance on January 12, 1903, viz. 221,820 miles. Whilst not certain of the exact form of the curve after full moon, Prof. Barnard thinks there is no doubt that it rises.

Two measures of the crater itself gave a mean of 0″·63 when reduced to the above distance. This corresponds to an actual diameter of about 3600 feet. Other interesting details of the crater and the glow are given in Prof. Barnard's notes.

THE VERTICAL DISTRIBUTION OF THE METEOROLOGICAL ELEMENTS ABOVE THE ATLANTIC.

In a previous article (vol. lxxiii. pp. 54–56) we described our expedition to the tropics, and gave the results of the observations with balloons and on mountains, so far as they related to the movements of the upper currents. In the present article we will consider the observations with kites, which furnished nearly continuous records of temperature, humidity, and wind velocity from sea-level to a height of 2300 metres, and the direct observations to a greater height which Mr. Clayton obtained in ascending and descending the tropical peaks on the islands of Teneriffe and Fogo. During a voyage of the White Star steamer *Romanic*, from Boston to Gibraltar, Mr. Clayton executed six kite-flights, and on board the steam-yacht *Otaria*, between latitudes 37° and 10° N., longitudes 16° and 31° W., with the assistance of M. Maurice, seventeen kite-flights were made, besides two in the harbour of Santa Cruz to investigate the sea breeze, and one in latitude 43° 43′ N., longitude 8° 43′ W., for the study of the changes in the free air produced by the total solar eclipse. The observations obtained at the height of 1000 metres, compared with those at sea-level, are given in Tables i. and ii. The first table contains the observations made in a general east and west direction between longitudes 69° and 16° W., latitudes 42° and 33° N. West of the Azores, that is to say, on the westward slope of the permanent area of high pressure, the decrease of temperature with height was slow, there being two cases out of the four in which the temperature increased immediately above the ocean, the average decrease in the thousand metres being but 0°·41 C. On the eastern and southern slopes of the high pressure the temperature decrease approached the adiabatic rate, amounting on the average to 0°·73 C. per hundred metres. The relative humidity diminished with altitude over the western barometric slope and increased in the observations obtained over the eastern slope, while the wind veered and increased with altitude in the former locality and backed with diminishing velocity in the latter. Fig. 1 shows the typical vertical distribution of the meteorological elements to the westward of the Azores.

The observations made at the height of 1000 metres and at sea-level in a general north and south direction, between latitudes 35° and 10° N., appear in Table ii. It will be seen that the temperature decrease is most rapid (average 0°·78 C. per 100 metres) near the northern and southern limits of the north-east trades, and is least rapid within the trade-wind region (average 0°·07 C.), due to the presence of strata with inverted temperature gradients, of which a typical example, with the corresponding changes of humidity, is shown in Fig. 2. The relative humidity varies inversely with the temperature, being slightly greater at 1000 metres just outside the trade wind, and much less at this height within the trade belt. While the observations of wind do not indicate any marked deviation from the north-easterly direction, there is a considerable decrease in the velocity of the trade with increasing height.

Mr. Clayton's study of the data collected in the tropics points to the existence of three strata between the sea and 4000 metres, characterised by differences in tempera-

TABLE I.—*Conditions at sea-level and at 1000 metres over the Atlantic, between Longitudes 69° and 16° West.*

Date	Long. W.	Temperature in degrees Centigrade			Humidity			Wind direction		Wind velocity in metres per second		
		0	1000 metres	Diff.	0	1000 metres	Diff.	0	1000 metres	0	1000 metres	Diff.
1905								°	°			
June 3	69	11·0	7·5	− 3·5	86	87	+ 1	—	—	—	—	—
June 6	47	15·8	13·4	− 2·4	96	52	− 44	S. 14 W.	S. 32 W.	8·5	12·0	+3·5
June 7	39	19·8	13·4	− 6·4	90	73	− 17	S. 9 W.	S. 20 W.	5·5	5·7	+0·2
Means	—	—	—	− 4·1	—	—	− 20	—	—	—	—	+1·8
June 10	19	17·5	9·8	− 7·7	68	60	− 8	—	—	—	—	—
July 3	16	23·0	13·3	− 9·7	71	100	+ 29	N. 28 E.	N. 8 W.	7·0	6·5	−0·5
July 4	16	20·8	16·3	− 4·5	—	—	—	—	—	—	—	—
Means	—	—	—	− 7·3	—	—	+ 11	—	—	—	—	−0·5

TABLE II.—*Conditions at sea-level and at 1000 metres over the Atlantic, between Latitudes 35° and 10° North.*

Date	? Lat. N.	Temperature in degrees Centigrade			Humidity			Wind direction		Wind velocity in metres per second		
		0	1000 metres	Diff.	0	1000 metres	Diff.	0	1000 metres	0	1000 metres	Diff.
1905								°	°			
Aug. 19, p.m.	35	23·8	15·9	− 7·9	80	90	+ 10	N. 56 E.	N. 56 E.	8·0	13·5	+5·5
Aug. 19, a.m.	35	23·6	14·7	− 8·9	79	96	+ 17	N. 64 E.	N. 64 E.	7·0	10·0	+3·0
Aug. 18, p.m.	34	23·7	16·5	− 7·2	84	92	+ 8	N. 33 E.	N. 26 E.	6·0	5·5	−0·5
Aug. 18, a.m.	34	23·2	15·8	− 7·4	83	90	+ 7	N. 38 E.	N. 50 E.	8·0	10·7	+2·7
Means	—	—	—	− 7·8	—	—	+10·0	—	—	—	—	+2·7
Aug. 14	31	21·7	23·7	+ 2·0	85	18	− 67	N. 6 E.	N. 27 W.	13·0	5·0	−8·0
Aug. 9*	28	23·2	23·9	+ 0·7	72	41	− 31	S.E.	Calm	1·0	0·0	−1·0
Aug. 10*	28	23·6	21·1	− 2·5	82	85	+ 3	N.E.	Calm	3·0	0·0	−3·0
July 12	27	20·3	28·9	+ 8·6	84	9	− 75	—	—	—	—	—
Aug. 4	24	23·0	19·0	− 4·0	76	52	− 24	N. 28 E.	N. 60 E.	8·0	9·0	+1·0
July 15	19	22·7	22·6	− 0·1	89	52	− 37	—	—	—	—	—
July 20	16	24·3	21·2	− 3·1	83	48	− 35	?	N. 57 E.	6·0	10·5	+4·5
July 27 †	15	25·7	28·2	+ 2·5	68	13	− 55	E.	N.E.	8·0	9·5	+1·5
July 28 †	15	25·2	20·5	− 4·7	60	66	+ 6	N.	S.	7·0	1·5	−5·5
Means	—	—	—	−0·07	—	—	− 35	—	—	—	—	−1·5
July 24	11	26·0	18·7	− 7·3	83	93	+ 10	—	—	—	—	—
July 22	10	24·0	18·0	− 6·0	96	100	+ 4	—	—	—	—	—

* Peak of Teneriffe. † Peak of Fogo.

ture, humidity, cloudiness, and wind. The trade wind, limited to about 1000 metres in thickness, varies in direction between north and east, is damp, and usually carries cumulus or strato-cumulus clouds in its upper portion. Above the surface trade is a current about 2000 metres in depth, varying in direction between north-east and north-west, but coming always from a direction to the left of the lower wind when facing it. This current is extremely dry and potentially warm, and its velocity is usually much greater than that of the lower wind. At their plane of meeting occurs a belt of calms or light winds with a marked inversion of temperature, and this rise of temperature is

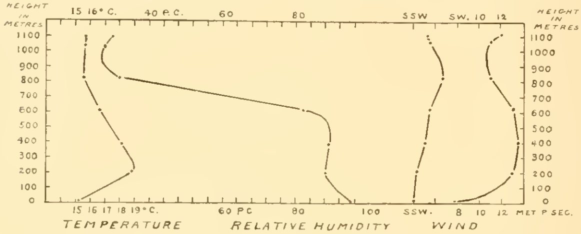


FIG. 1.—Vertical Distribution of Temperature, Humidity and Wind, June 6, 1905; Lat. 40° 33′ N., Long. 46° 43′ W.

accompanied by a very decided fall of humidity, the relative humidity in some cases falling to nearly zero. The third stratum, which begins at a height of about 3000 metres, moves from a direction varying between east and south or south-west, being generally from the east in equatorial regions and from the south between latitudes 15° and 30° N. As observed on the Peak of Teneriffe, this stratum was dry in its lower portion, but had a slightly larger vapour contents than the air immediately below. Alto-cumulus and alto-stratus clouds were seen floating in it at a height of perhaps 4000 metres or 5000 metres, and from them light sprinkles of rain fell occasionally. In passing into this upper current a rise of temperature was noted, but this was less marked than

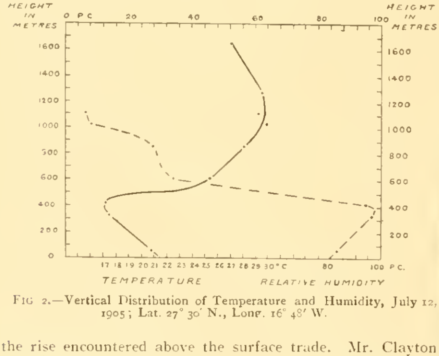


FIG 2.—Vertical Distribution of Temperature and Humidity, July 12, 1905; Lat. 27° 30′ N., Long. 16° 48′ W.

the rise encountered above the surface trade. Mr. Clayton also deduces the following facts from the observations:—(1) the bases of the cumulus clouds are low over the ocean, rarely exceeding 500 metres; (2) the height of the inverted temperature gradient varies from day to day between 300 metres and 1500 metres, with a probable average of 1000 metres, and its height also appears to undergo a diurnal change, being lowest at night or in the morning and highest in the afternoon; (3) the adiabatic rate of decrease of temperature prevails over the ocean at night as well as during the day.

The vertical distribution of temperature and humidity revealed by our observations up to a height of 4000 metres agrees in general with that found by Prof. Hergesell during the cruises of the Prince of Monaco's yacht in 1904 and 1905 (see *Comptes rendus de l'Académie des Sciences*, January 30, 1905, and *Bulletin du Musée Océanographique de Monaco*, November 30, 1905). From the latter publication it is interesting to learn that a balloon, liberated by Prof. Hergesell on August 7 last far to the westward of the Canary Islands, indicated the same currents which were found by us in the neighbourhood of these islands, since it met the south-east and south-west winds above the north-east trade. It is significant that this balloon reached a greater height than did the other balloons, which showed winds having a northerly component. We perceive that Prof. Hergesell no longer denies the possibility of an upper anti-trade in a lower latitude than the Canaries, but now simply states that in the central part of the Atlantic he found almost exclusively north-west winds, from which he concludes that the route followed by the currents bringing the air from the equator appears to be less simple than had been supposed, and seems to depend on the relative positions of the continents and oceans. The study of the daily isobars over the ocean, which was first made under the direction of Le Verrier in 1864, showed that the pressure is not distributed in uniform belts, and that the isobars are everywhere deflected by the influence of temperature distribution dependent upon the land and sea, relations which were demonstrated by M. Teisserenc de Bort's study of isonormals more than twenty years ago. Hence it would appear that there are certain regions where the anti-trade is more regular than elsewhere, the zone between the Cape Verde and Canary Islands being no doubt one of these; but this view is quite contrary to the idea that the south-east and south-west winds observed in the upper atmosphere near these islands, and hitherto accepted as proof of the anti-trade, are due to local influences, which Prof. Hergesell still affirms to be true.

A. L. ROTCH.
L. TEISSERENC DE BORT.

THE TRANSFORMATIONS OF ROCK-MASSES.[1]

THE study of the changes which rock-masses undergo under natural conditions is in itself by no means an inconsiderable branch of geology, and its pervading importance throughout the whole field of the science brings it continually to the front in stratigraphical as well as petrological research. The literature of the subject is a large one, but until now no serious attempt has been made to deal fully and comprehensively with the principles and phenomena of metamorphism as a whole. Prof. van Hise's wide experience in the Lake Superior region and elsewhere has made him well fitted for a task to which he has devoted seven years of labour; and the outcome of that labour, as represented in the massive volume before us, will have a permanent value for all who come after him in this field.

This treatise, as we are told in the preface, is "an attempt to reduce the phenomena of metamorphism to order under the principles of physics and chemistry, or, more simply, under the laws of energy." Metamorphism is understood to include all alterations of all rocks by all processes. This extension of customary usage may be defended on logical grounds, and it has the advantage of constantly keeping in view the essential unity underlying the complex operations of nature; but it involves a corresponding enlargement of the subject-matter. The scrupulous—almost relentless—manner in which the author follows out in every detail the general scheme of treatment laid down further swells the bulk of the volume, and, brought out in the handsome style which characterises the produc-

1 "A Treatise on Metamorphism." By Charles Richard van Hise. (Monographs of the U.S. Geological Survey, vol. xlvii.) Pp. 1286 and 13 plates. (Washington, 1904.)

tions of the Survey, it is physically not an easy book to handle.

In the first chapter a general discussion leads to the conclusion that the most important factor in metamorphism is the depth of the rocks below the surface. In the upper zone of the earth's crust the chemical changes are such as result in the production of simpler compounds from more complex ones, while in the deeper part the reverse is the case. The starting point of the author's treatment is this antithesis between the upper zone of *catamorphism* and the lower zone of *anamorphism*. It appears to us that, while the broad rule here laid down is doubtless of significance, it has scarcely sufficient precision to serve as a basis of classification. The productions of muscovite from orthoclase, and of natrolite from albite, are, according to this geological distinction, catamorphic changes, but it cannot be said that they result in the formation of simpler from more complex compounds.

The second chapter deals with the forces of metamorphism, and the third with the agents of metamorphism, *i.e.* especially gaseous and aqueous solutions. This involves a *résumé* of the principles of physical chemistry, so far as they are applicable to the subject. Although somewhat handicapped by the author's scepticism concerning the doctrine of electrolytic dissociation, this summary will be very useful to students of geology. Chapter iv. treats of the characteristics of the two zones of metamorphism. The law is found to be that in the zone of catamorphism the alterations are attended by liberation of heat and expansion of volume; in the zone of anamorphism by absorption of heat and diminution of volume. The zone of catamorphism is divided into the belt of weathering, lying above the level of underground water, and the belt of cementation, lying below that level; and the geological processes characteristic of these two belts are contrasted.

Chapter v., which might perhaps have been abridged without impairing the value of the book, considers the actual alterations undergone in nature by each of the rock-forming minerals. The chemical reactions are illustrated by equations, and the percentage increase or decrease of volume is calculated in each case. The precise application of these calculations is perhaps debatable, since special assumptions have to be made regarding such gaseous and soluble substances as take part in the reactions, and in some cases the equations themselves are rather conjectural. The next three chapters are an analysis of the processes of change in the belt of weathering, the belt of cementation, and the zone of anamorphism respectively. Under the last head the most important discussion is that relative to secondary gneissic and schistose structures. The author concludes that "Rock-flow is mainly accomplished through continuous solution and deposition, that is, by re-crystallisation of the rocks through the agency of the contained water. But rock-flow is partly accomplished by direct mechanical strains." The ninth chapter deals with the phenomena of metamorphism of individual rocks, and with this the systematic treatment of the subject ends; but there remain some interesting chapters applying the principles enunciated in this treatment to certain other branches of geology.

Chapter x. discusses the difficulties which metamorphism often introduces into stratigraphical investigation and the manner in which these difficulties may be overcome. The next chapter, which is the most novel part of the book, has for its subject the relations of metamorphism to the distribution of the chemical elements. It is shown that, as compared with the parent igneous rock-masses, most sedimentary rocks become impoverished in certain elements, which are thus segregated in particular deposits. Some of the numerical results are of a surprising kind. Thus, it is calculated that to oxidise the ferrous iron of the original rocks to the ferric state, in which most of it occurs in the sediments, required 35 per cent. of the oxygen now in the atmosphere. To oxidise the sulphur and iron of iron-sulphides to produce the sulphates of the ocean and gypsum deposits, with concurrent transformation of the iron to the ferric form, required one and a half times the oxygen now in the atmosphere. The final chapter, occupying no less than 240 pages, might perhaps have been deemed sufficiently complete in itself for separate publication. It is practically a treatise on the principles of ore-deposition. The subject is one upon which much divergence of opinion is still found. Prof. van Hise, as is well known from his former writings, has devoted long study to it, and the complete exposition which he now offers will be read with general interest. From his point of view, the majority of ore-deposits have been produced by metamorphism, in the broad sense of the term already defined, and it results that the theory of their genesis consists mainly in bringing the phenomena which they exhibit under the general principles of metamorphism. The conclusion is reached that in many cases the ores have resulted from repeated segregations of the kind considered in the preceding chapter.

FIG. 1.—Fairview Dome, Sierra Nevada, from the north; illustrating the manner in which granite scales parallel to the periphery as a result of expansion and contraction due to changes of temperature.

It is impossible to study Prof. van Hise's work without admiring the boldness of his design and the skill with which it is carried out, and being grateful for the stores of carefully arranged information which he has brought together. We must readily admit, too, that he has done good service in insisting upon the necessity for the geologist to familiarise himself with the recent progress of physical chemistry, a knowledge of which, as van 't Hoff and others have shown, is a pre-requisite for attacking many of the most pressing problems of geology. Granting this, however, we may still be permitted to doubt whether a purely geological subject like metamorphism is most advantageously dealt with in the manner which is appropriate to the exact sciences. In such a formal schematic treatment there is some danger of making it appear that our knowledge of metamorphism is to be deduced from chemical principles instead of depending upon observation. Although the criticism would not be a just one in the present case, we venture to express a wish that the author had chosen to describe the facts first and explain them afterwards, and that he had made freer reference to actual rocks and specified localities.

A. H.

A NEW OXIDE OF CARBON.

THE current number of the *Berichte der deutschen chemischen Gesellschaft* (1906, xxxix., p. 689) contains a preliminary communication by Messrs. Otto Diels and Bertram Wolf, of the Berlin University, giving an account of the preparation and properties of a new oxide of carbon having the composition C_3O_2, for which they propose the name *carbon suboxide*. The new oxide is obtained from ethyl malonate, $CH_2(CO_2C_2H_5)_2$, by subjecting the vapour of the latter to the action of phosphorus pentoxide at 300°; under these conditions two molecules of water are removed by the action of the latter reagent, and a mixture of ethylene and carbon suboxide formed, the reaction being expressed by the equation

$$CH_2(CO_2C_2H_5)_2 = 2C_2H_4 + 2H_2O + C_3O_2.$$

The ethylene and carbon suboxide are condensed together in a receiver cooled with liquid air, and subsequently separated by fractional distillation.

Carbon suboxide is a gas at the ordinary temperature, which burns in the air with a smoky flame, has a most penetrating smell, resembling that of acroleïn and mustard oil, and attacks the eyes, nose, and respiratory organs violently. On cooling it condenses to a colourless, highly refractive liquid, which boils at 7° under 761 mm. pressure. The results of the analysis and of the determination of the vapour density show that the molecular formula is C_3O_2.

Carbon suboxide at once combines with water, re-forming malonic acid, and also unites with ammonia, hydrogen chloride, and aniline, forming malonamide, malonyl chloride, and malonanilide respectively; it therefore contains the chain of carbon atoms previously existing in the malonic acid derivative from which it is prepared, and in all probability possesses the constitution represented by the formula OC : C : CO. Hence in both its constitution and properties it has a close analogy with the metallic carbonyl derivatives, and especially with Mond, Langer, and Quincke's nickel tetracarbonyl, $Ni(CO)_4$.

When the liquid suboxide is sealed in glass tubes it slowly undergoes change at the ordinary temperature, and is finally converted into a dark red solid, which dissolves in cold water, yielding an intense eosin-red solution. At higher temperatures the alteration takes place much more rapidly, and the product is then no longer completely soluble in water. The nature of the changes here taking place is still under investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—One hundred and fifty-five students have entered for the First Part of the natural sciences tripos and twenty-five for the Second Part in the coming June. In the mechanical sciences tripos there are fifty candidates. These figures show a considerable increase in the numbers for the last few years. There are seventy-seven in for the First Part of the mathematical tripos, and seven entered for the Second Part.

The Vice-Chancellor has announced that the Girdlers' Company has offered to renew, for a further period of three years, its grant of 100*l.* a year towards the study of economics in Cambridge.

The General Board of Studies has approved for the degree of doctor in science Mr. F. W. Keeble, Gonville and Caius College.

The Special Board for Physics and Chemistry has agreed to expend its share of the Gordon Wigan Fund as follows:—(1) A sum of 50*l.* per annum is to be granted to the department of chemistry for five years for the establishment of a prize or otherwise for the encouragement of research in chemistry. (2) The balance of the income is to be used for the assistance of research and teaching amongst the departments of the University directly connected with the Board, other than that of chemistry, it being understood that on the average the departments should share equally. (3) Applications for grants are to be made by the heads of departments and be considered at a meeting of the Special Board held not later than the division of the Michaelmas term in each year. Grants not exceeding 74*l.* have been made out of the balance on income account for 1905 to the departments of physics and mineralogy to defray the cost of special apparatus.

IT is reported from Berlin that Mr. Alfred Beit has presented 100,000*l.* to Hamburg for the establishment of a university.

THE Goldsmiths' Company has made a grant of 1000*l.* to the building and endowment scheme for Bedford College, University of London. The Grocers' Company has granted 25*l.* for the same purpose.

THE Goldsmiths' Company has made a grant of 10,000*l.* to the Institute of Medical Sciences Fund, University of London, on the assumption that a site will be provided for the institute at South Kensington.

PRESIDENT THOMAS, of Bryn Mawr College, has announced, says *Science*, a gift of 16,000*l.* from Mr. John D. Rockefeller, to enable the college to meet the expenses incurred by the trustees over and above the gift of 50,000*l.* in 1902 for the new library. Mr. Rockefeller has contributed in all 91,000*l.* to the college. From the same source we learn that McGill University will receive 10,000*l.* from the estate of the late Mr. Edwin H. King, former general manager of the Bank of Montreal.

MR. F. C. FORTH, principal of the Municipal Technical Institute, and director of technical instruction for Belfast, has compiled a very useful "Student's Guide to Prizes and Scholarships." The guide is primarily intended for the information of present and future students of the institute over which the compiler presides, but, as it contains details of scholarships at universities and other institutions of higher education, it should appeal to a wide circle of students elsewhere. The guide demonstrates in a convincing manner the numerous facilities in existence to assist earnest students of slender means to continue their education so far as their abilities allow.

MR. WYNDHAM, M.P., delivered an address at the distribution, on March 3, of prizes won by the students of the Dover municipal schools of science, art, and technology. He said the study of science is the study of truth. The pursuit of science is not beset by those pitfalls which are now called "terminological inexactitudes." In science, if the cause is known the effect can be foretold; it is the only safe form of prophecy. The pursuit of pure science is the noblest calling to which earnest endeavours can be given. The present age is preeminently the age of science, and all who study it feel they are comrades in the great quest for truth. The pursuit of science has brought in its train gifts of various kinds, and to the worker in technology it has brought perhaps the greatest gift that anyone can obtain—the gift of independence, not only pecuniary independence, but the gift to men and women of an ample field for their own energy in which they can win distinction, and at any rate justify their existence upon earth.

ON February 28, in the presence of a large and representative gathering of agriculturists, representatives of county councils, the Scotch Education Department, and others interested in agricultural education, Lord Balfour of Burleigh formally opened the new buildings of the Edinburgh and East of Scotland College of Agriculture. The new buildings, situate in George Square, Edinburgh, consist of well equipped chemical, botanical, and bacteriological laboratories and lecture-rooms, and class-rooms for the various other subjects which form part of the college course. Adequate provision is also made for the staff of lecturers engaged in extension work in the counties. The cost of the present scheme has amounted to more than 9000*l.*, and has been almost entirely met by grants from the Scotch Education Department, the Carnegie Trust, the Highland and Agricultural Society, and subscriptions from landowners and farmers. In the course of an interesting address, Lord Balfour referred with satisfaction to the improved relations which now exist between the farmer and those engaged in the work of agricultural education and in the application of the various sciences to the investigation of agricultural problems.

THE Education Committee of the London County Council has issued a report, drawn up by a subcommittee, dealing with the question of apprenticeship. A carefully thought out scheme of scholarships for particular cases is, the report states, the only effective, as well as the only legal, substitute for the old-fashioned apprenticeship premium within the reach of a local authority. The report shows that there are in London various apprenticeship charities with an aggregate income of 24,000*l*. a year, and not more than one-third of this sum has been expended in the payment of premiums. It is suggested that these funds might with advantage be devoted to technical scholarships for poorer children in higher elementary schools, or to the maintenance of boys while they are attending day technical instruction, and thus unable to earn wages. Attention is directed in the report to the lack of technical training in London, and the subcommittee urges that if the apprenticeship system is destined to disappear, it is necessary to find a substitute for such training. Scholarships tenable at evening classes, industrial scholarships at day technical classes, and at trade schools, and the part-time system by which the boy or girl spends a portion of the day in the workshop and the remainder in a day technical school, are mentioned as ways of training which will take the place of the old indentured apprenticeships.

THE scheme of training urged upon the London County Council by its Education Committee as a substitute for the apprenticeship may be summarised briefly as follows:—The intelligent boy, as he leaves the elementary school, will have offered him the choice of two courses of instruction which will assure him an all-round training in a skilled trade. There will be, first, the "part-time" system, in which he will spend a portion of the week in the workshops and the remainder in the day technical school, and, secondly, there will be evening classes. In certain cases scholarships carrying free tuition and a maintenance grant will be awarded to the day students to compensate for the small earnings received during the years of training. Other scholarships of less value will be allowed to some of the evening students in order to encourage regularity of attendance. From this class of student will be drawn the skilled worker of the future. The boy, as he leaves the higher elementary school, will be able to enter the day trade school, either by paying the fees himself or by winning one of the trade scholarships. With this stream of boys coming from the higher elementary school will mingle another stream of boys who, having completed their course at the secondary school, have competed for one of the trade scholarships. From this class of student will be drawn the future foremen and managers of industrial undertakings. Finally, a development of the senior County Council scholarships will make it possible, not only for intermediate scholars, but also for certain of the holders of trade scholarships, to proceed, for the highest technological instruction in the engineering, electrical, chemical, or other industries, to the university. From these will be drawn, we may hope, the future inventor, the future managers of large businesses, and the future "captains of industry." A somewhat less elaborate system will afford similar facilities for girls.

THE science laboratories and class-rooms at Dulwich College have long been inadequate for the demands made on them. The governors of the school, with their chairman, Lord Davey, have now, owing to the cooperation of the Estates Governors with the Charity Commissioners and the Board of Education, been able to commence the building of a new science school, the foundation-stone of which was laid with due ceremony on Saturday last by Lord Rayleigh, P.R.S. The school is to consist of two floors, the upper for chemistry, providing an advanced laboratory, a large combined lecture-room and laboratory, a junior laboratory, a separate lecture-room with preparation store, and balance rooms; the lower for physical science, and containing a senior and junior laboratory, two lecture-rooms, and a school museum. Provision is also made for a master's room, a photographic dark-room, and a small workshop. The building is being erected from the plans of the school architect, Mr. C. E. Barry. In his speech in the great hall Lord Rayleigh contrasted the old and present position of science in schools. He pointed out that scientific spirit and method should be the aim of the teaching. In the present-day provision of elaborate apparatus and fittings things were in danger of being made too mechanical. He mentioned the simple apparatus used by Maxwell, and by Hughes for the microphone, who carried simplicity almost to an absurdity. The charms of accurate measurement were briefly touched upon. He thought there was also a tendency to try and cover too much ground in science teaching at schools; less, more thoroughly done, would be better. His own classical education was not literary enough; he was taught no English composition. Modern languages would be better than Greek for very many boys.

THE London Inter-collegiate Scholarships Board was constituted in 1904 with the approval of the governing bodies of University College, King's College, and the East London College, for the purpose of holding a combined annual examination for entrance scholarships and exhibitions tenable at those colleges. One examination has been held already, and with satisfactory results. The next examination will take place in London on May 15 and following days. The competition is limited to those who have not previously been students at any one of the colleges, except where the contrary is stated. No candidate will be admitted to the examination unless he has passed the matriculation examination of the London University, or any examination accepted by the University in lieu thereof, or is the holder of a school leaving certificate, or is able to furnish some evidence of having had a sound general education which is satisfactory to the Board. Application should be made to the secretary of the Board, University College, London, Gower Street, W.C., for forms of entry, which must be returned not later than May 1. Any scheme tending to diminish the number of examinations to which pupils in secondary schools are subjected is to be welcomed, and we trust that the schoolmasters of London will appreciate the efforts of this Board. The insistence upon the possession of a good general secondary education by the holders of scholarships at the group of colleges concerned is a step in the right direction, and it is to be hoped this example will be copied by similar institutions throughout the country.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 2, 1905.—"On the Electr Resistance to the Motion of a Charged Conducting Sphere in Free Space or in a Field of Force." By G. W. **Walker.** Communicated by Prof. A. E. H. Love, F.R.S.

November 16, 1905.—"First Photographs of the Canals of Mars." By Prof. Percival **Lowell,** Flagstaff Observatory, Arizona. Communicated by Sir Norman Lockyer, K.C.B., F.R.S.

With this paper the author communicates a number of photographs which undeniably prove the objective reality of the Martian canals. From a large number of photographs obtained by Mr. Lampland during May and June, 1905, five have been selected for publication, and when these are studied with the contemporaneous, yet quite independent, drawings made by Prof. Lowell, the more prominent canaliform features on the Martian disc are plainly seen.

The photographs show, so far as the grain of the photographic plate permits, that the canals are narrow and direct lines following arcs of great circles or curving in a systematic manner. There is evidence, although for the present the author does not care to assert it definitely, that both a *double* canal and a *double* oasis have been photographed.

One remarkable result that has accrued from Mr. Lampland's researches is the increased efficiency to be obtained by diaphragming down the objective, so that its effective aperture becomes equal to, or less than, the length of the atmospheric waves obtaining at the moment of observation. If the aperture is so large that more than one such wave is in front of the objective at the moment of exposure, poor definition results, caused by the consequent quiver in the rays from the planet; but if only one wave be included, the atmospheric displacement of all the rays is homogeneous, and good definition results.

In obtaining the photographs a colour screen and Cramer isochromatic plates were employed, and the camera was made movable so that numerous successive photographs might be obtained on the same plate, thereby greatly increasing the chance of obtaining at least one well defined photograph at each observation. About 700 images of the planet were secured in this way during the short time that it was favourably placed for such work during the opposition of 1905.

December 7, 1905.—"On Mathematical Concepts of the Material World." By Dr. A. N. **Whitehead,** F.R.S.

January 25.—"Galvanic Cells produced by the Action of Light.—The Chemical Statics and Dynamics of Reversible and Irreversible Systems under the Influence of Light." (Second Communication.) By Dr. Meyer **Wilderman.** Communicated by Dr. Ludwig Mond, F.R.S.

February 15.—"The Chemical Constitution of Protoplasm as shown by the Rate of Tissue Disintegration." By Dr. H. M. **Vernon.**

If a kidney be perfused with saline solution for five to eight days, it is found that from 28 per cent. to 60 per cent. of the tissues pass into solution. These constituents consist of proteid and proteid disintegration products, and contain a good deal of the peptone-splitting ferment erepsin. Sometimes the passage of the kidney tissue from life to death is quite gradual, with no accompanying disintegration. At other times it takes place suddenly, and the proteid and ferment washed out of the kidney may very quickly increase four- to twenty-fold, and then dwindle away again. Sudden and very marked disintegration is invariably produced by adding ether or chloroform to the perfusion liquid. Sudden death produced by perfusion with NaF does not lead to any sudden disintegration. The rate of disintegration is extremely responsive to changes in the perfusion liquid, *e.g.* substitution of 1 per cent. saline for 4 per cent. saline caused a thirty- to sixty-fold increase in the disintegration both of ferment and proteid groups. On the other hand, if already perfused saline were sent through the kidney a second time, the proteid disintegration might be *diminished* to a seventh its previous value, but the ferment disintegration *increased* even twenty-fold.

After the first few hours' perfusion, a roughly constant amount of nitrogen continues to break away from the tissues in a non-proteid form, though the proteid breaking away at the time may vary as 1 to 1300. It is produced by autolysis. Almost the whole of the nitrogen is present in the tissues as potential proteid, and may be made to break off as actual proteid; but if the kidney be perfused with saline containing 0·1 per cent. of lactic acid—which has no action on ordinary proteid—more than half the unstable potential proteid of the tissues is split up.

These results seem to indicate that the difference between living and dead tissues is one of degree rather than of kind, for the dead tissues show great lability, and their self-decomposition is greatly augmented by stimuli.

Anthropological Institute, February 13.—Prof. W. Gowland, president, in the chair.—Two clay images used by the A-Kikuyu of British East Africa in harvest ceremonies, and a slide showing four remarkable dance armlets used by the natives on these occasions: **Secretary.** The images were about 9 inches in height, and were very rude representations of the human figure; they appear to be greatly venerated by the natives; the two specimens shown were, so far as is known, the only ones that have reached Europe.—Selection of slides showing rude stone monuments in Glamorganshire: A. L. **Lewis.** The author described the monuments at Tinkinswood, near Cardiff, the fine cromlech at St. Lythian's which bears close resemblance to that at Kit's Coty House. At Pontypridd there is a curious group of stones consisting of a rocking stone, surrounded by two circles and two small curved avenues forming the head and tail of a serpent. This group has been considered by many to be ancient, and ingenious theories have been woven round it, but Mr. Lewis was able to prove conclusively that the stones had not been in position for very much longer than fifty years. Mr. Lewis also showed slides of the dolmen at Lanyon Quoit.—Notes on Deluge legends, tracing their distribution: N. W. **Thomas.**

Linnean Society, February 15.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—A lantern demonstration of the developmental changes in Zooglœa: Dr. H. C. **Bastian.** Masses of Zooglœa in their early stage were first shown, in which the constituent bacteria were plainly recognisable. The growth of the masses, their alteration in appearance and in reaction to staining fluids, together with the progressive segmentation which they undergo, were revealed by other specimens. Segmentation was shown to progress until minute spherical or ovoidal units were produced. During the first three to five days, while these changes are occurring, the masses remain colourless and the ultimate segmentation units develop into flagellate Monads, or, more rarely, into equally minute Amœbæ—myriads of one or of the other of these forms appearing (all of about the same size) where a few hours before they were absent. Later, from fifth to tenth day, the ultimate segmentation units of other masses appear as aggregates of brown fungus-germs. Often the masses as a whole become brown before segmentation has much advanced, and the different stages were shown by which the bacterial aggregates are completely converted into masses of brown fungus-germs, together with the development of hyphæ therefrom. All the stages in the complete conversion of the Zooglœa masses into Monads or Amœbæ in the one case, or into brown fungus-germs in the other, are clearly recognisable, though it is impossible to say from the appearance of the masses in their early stages which of these three interchangeable forms of life will ultimately be produced.—The structure of *Isis hippuris* (Linnæus): J. J. **Simpson.** The species in question is the only one remaining in the genus, the other eighteen formerly included having at various times been removed to other genera of Alcyonaria. It is widely distributed, being found in Iceland, the Mediterranean, Indian and Pacific Oceans, though no specimen was found in the *Challenger* collections. The investigation was conducted on a series of specimens obtained by the Indian survey ship *Investigator,* from the surf-line and from 20 fathoms in the Andaman Sea.—Note on the distribution of the genus Shortia (Torr. and Gray): B. Daydon **Jackson.** By the aid of lantern-slides, the distribution of the genus was indicated, and various species described, with their distinguishing characters shown.

Zoological Society, February 20.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—A new drawing of the skeleton of the Triassic rhynchocephalian, *Rhynchosaurus articeps*, from the Keuper Sandstone of Shropshire: Dr. A. Smith **Woodward.**—Breeding experiments with Lepidoptera: L. **Doncaster** and the Rev. G. H. **Raynor.** The species used were *Angerona prunaria* and its var. *sordiata,* and *Abraxas grossulariata* and its var. *lacticolor.* In *A. prunaria* the banding of the var. *sordiata* was dominant over its absence in the type, but the speckling characteristic of the type appeared in the heterozygote, so that the latter was both banded and speckled. The characters appeared to segregate in the typical Mendelian manner, but in several families there was an excess of *prunaria* over *sordiata.* In *A. grossulariata* the var. *lacticolor* was a Mendelian recessive, but was normally found only in the female. By pairing a heterozygous male with a *lacticolor* female, *lacticolor* males and females were obtained. *Lacticolor* male × female gave only *lacticolor*; *lacticolor* males by heterozygote females had given all males of the type, all females *lacticolor.*—Tracheophone Passeres: W. P. **Pycraft.** The author proposed to make the Tracheophone Passeres one of four great divisions of the passerine stem. The most primitive of the divisions would contain the Eurylæmidæ, Cotingidæ, and Philepitta. The second would be represented by the Tracheophonæ, the third by the Tyrannidæ and Pittidæ, and the fourth by the rest of the Passeres.—A collection of mammals made by Mr. C. H. B. Grant at Knysna, and presented to the National Museum by Mr. C. D. Rudd: O. **Thomas** and H. **Schwann.** The collection consisted of about 150 specimens, belonging to 31 species or subspecies, of which the most noticeable was Mrs. Rudd's golden mole (*Amblysomus corriae*), the description of which had already been laid before the society. A new generic name, Nototragus, was applied to the grysbok, which differed from the other

members of Raphicerus by its possession of supplementary hoofs.—Habits of the Australian lung-fish (*Ceratodus forsteri*) as observed in the society's menagerie: Prof. B. **Dean.**

Royal Meteorological Society, February 21.—Mr. Richard Bentley, president, in the chair.—Report on the phenological observations for 1905: E. **Mawley.** As affecting vegetation, the weather of the phenological year ending November, 1905, was chiefly remarkable for the dryness and mildness of the winter months, the drought and frosts in May, the long spell of hot and dry weather in July, and an exceptionally cold period in October.—Brief discussion of the general features of the pressure and wind conditions over the trades-monsoon area: W. L. **Dallas.**—The dispersal or prevention of fogs: Dr. W. B. **Newton.**

CAMBRIDGE.

Philosophical Society, January 29.—Prof. Thomson, vice-president, in the chair.—The expansion of a gas into a vacuum and the determination of the specific heat at constant pressure for gases: G. F. C. **Searle.** If gas, which is initially stored in a receiver at a high pressure, be allowed to expand into an exhausted vessel, and if the temperature of the whole mass of gas be allowed again to become uniform, without any gain or loss of heat, the final temperature (t') will differ from the initial temperature (t) unless U, the energy of a gram of gas, is independent of the volume. For a gas obeying Van der Waals's equation $(p+a/v^2)(v-b)=Rt$, it is shown that, when the volume of one gram increases from v to v', the change of temperature is given by $t-t'=a/C_v(1/v-1/v')$. Regnault's method of determining the specific heat of gases at constant pressure is shown to be an extreme case of the Thomson-Joule porous plug experiment.—The action of radium and other salts on gelatin: W. A. D. **Rudge.** The author has shown that barium salts produce the same effect upon gelatin as is the case with radium salt, and concludes from his experiments that radium has no specific action upon gelatin, any result obtained being due to the action of the barium in the radium salt upon the sulphur compounds present in the gelatin.—A novel instrument for illustrating the magnetic properties of iron: A. H. **Peake.** In this instrument a strong magnetic field is produced by sixteen bar magnets; this field, which is normally horizontal, may be slightly inclined at will by rotating a turn-table, to which the permanent magnets are attached, through a few degrees. The specimen of iron under test is very thin in proportion to its length; it is supported in a freely pivoted cradle to which a control weight and a long pointer are attached; the axis of the cradle is in the same straight line with that of the turn-table.—The susceptibility of iron in colloidal solution: E. F. **Burton** and P. **Phillips.** The paper is an account of experiments made to determine the susceptibility of a colloidal solution of iron in methyl alcohol. The susceptibility found indicates that iron in colloidal solution has much stronger magnetic properties than it would have if it existed merely as a ferric (or ferrous) salt in the solution; on the other hand, the magnetic properties are weaker than those of pure iron. The results seem to point to the conclusion that each particle in the colloidal solution consists of a core of pure iron surrounded by a layer of some compound of iron, *e.g.* the hydroxide.

MANCHESTER.

Literary and Philosophical Society, January 16.—Sir William H. Bailey, president, in the chair.—Behaviour of liquid films formed from a solution of saponin in water: H. **Stansfield.** Although saponin films have very little mobility, they are capable of becoming extremely thin. The limiting thickness of a black saponin film is comparable with that of the thinnest soap film. In the process of thinning, the saponin films exhibit a grey stage; and there are two characteristic abrupt changes in thickness, the first from the white of the first order to the grey, and the second from the grey to the black.—Battack printing in Java: J. **Allan.** The process of battacking is more akin to dyeing than to printing. The white cotton is first freed from the starchy and saline matter of the "finish" by frequent washings and exposure in the wet condition to the sun. When thoroughly dried and cut into sarong lengths it is ready to be printed. The whole fabric is immersed in a dye bath, the parts not intended to be coloured being protected by previously overlaying them with a coating of wax, placed on in such a way as to form a design. In the coarsest cloths the design is drawn in with a thick brush by the women; in those of finer quality it is stamped with a metal die by the men.—Remarks on the germinal layers of vertebrates and on the significance of germinal layers in general: J. W. **Jenkinson.**

January 30.—Mr. Francis Nicholson in the chair.—The origin of the salt in the sea: R. L. **Taylor.** The paper was a contribution to the controversy which began more than thirty years ago between Dr. Sterry Hunt and David Forbes. Hunt (whose views Mr. Taylor endorsed) contended that on the original cooling of the globe, and before the condensation of the water, the alkali metals, sodium and potassium, existed in the crust of the earth entirely as silicates, the primitive atmosphere containing the chlorine as hydrochloric acid, and also probably sulphuric acid. When the water condensed these acids dissolved in it, and the primitive ocean was thus really dilute acid. This acid, however, soon became neutralised as it vigorously attacked the silicates of which the crust of the earth was composed. The calcium and magnesium, dissolved out of the primitive rock at the same time as the alkalies, have been gradually replaced by sodium carried down as carbonate by rivers.

February 13.—Sir William H. Bailey, president, in the chair.—Report on the recent Foraminifera from the coast of the island of Delos, part iii., Lageninæ: H. **Sidebottom.** The writer directed attention to the points of difference that occur in the same species, and stated that some of the species found have not previously been reported from the Mediterranean. Drawings of the most interesting forms obtained were exhibited and described.

PARIS.

Academy of Sciences, February 26.—M. H. Poincaré in the chair.—Researches on some metals and minerals found in the excavations at Susa, in Persia: M. **Berthelot** and G. **André.** The objects examined come from the earliest Elamite period, earlier than 750 B.C., and analyses are given of articles of silver, copper, bronze, lead, and lead silicate.—The propagation of a movement round a centre in an elastic homogeneous and isotropic medium: study of the wave correlative to the variations in density: J. **Boussinesq.**—Some difficulties presented by the estimation of carbon monoxide in gaseous mixtures: Armand **Gautier** and M. **Clausmann.** Synthetical mixtures of carbon monoxide with hydrogen and air were analysed by absorption with cuprous chloride and explosion with oxygen. It was found that the absorption by cuprous chloride, even in two successive treatments, was never complete, and that measurable amounts of carbon monoxide escaped oxidation by explosion.—An important inequality in the study of quasi-waves of shock: P. **Duhem.**—The addition of hydrochloric acid to isobutylene oxide, $\underset{\quad\quad O}{(CH_3)_2.C—CH_2}$: Louis **Henry.** Isobutylene oxide reacts with concentrated hydrochloric acid, a new chlorhydrin, $(CH_3)_2.CCl.CH_2(.OH)$, being formed. The starting point for the preparation of the isobutylene oxide was the isomeric chlorhydrin, $(CH_3)_2.C(OH).CH_2Cl$, prepared from monochloracetone by Grignard's reaction. The physical and chemical properties of these closely related isomers are compared.—M. Heim was elected a correspondant for the section of mineralogy in the place of M. de Richthofen.—The perpetual secretary announced the death of M. A. F. A. Bienaymé, correspondant for the section of geography and navigation.—Observations of the Brooks comet (1906*a*) made with the large equatorial of the University of Bordeaux: E. **Esclangon.**—The indeterminateness of a function of a variable in the neighbourhood of a transcendental singularity: Pierre **Boutroux.**—Fourier's series: Léopold **Fejér.**—The integrals of a differential equation in the neighbourhood of a di-critical point: H. **Dulac.**—The application of the analysis of Dirichlet to quadratic forms with coefficients: P. **Fatou.**—The theory of spectra: Ivar **Fredholm.**—The vibrations of an elastic body the surface

of which is at rest: A. **Korn.**—A particular case of the problem of n-bodies: Thadée **Banachiewitz.**—The exact significance of Carnot's principle: Louis **Fredey.**—Lævorotatory lactic acid: E. **Jungfleisch** and M. **Godchot.** l-Lactic acid is much more easily transformable than the d-acid into the $(d+l)$ acid, and increased care in working is in consequence necessary. The crystallised lævo-acid melts at 27° C., at approximately the same temperature as the dextro-acid.—The cysts of Glœosporium and their *rôle* in the origin of yeasts: P. **Viala** and P. **Pacottet.**—*Stellosphaera mirabilis,* a new larva probably belonging to an abyssal form: R. **Kœhler** and C. **Vaney.**—The recuperative effects of raw meat after fasting: Charles **Richet.** Experiments on dogs comparing the recuperative effect after fasting of cooked meat, broth, and raw meat showed that the latter food is the most efficacious.—Study of the variations in the toxicity of the contents of the small intestine: modifications of the blood: MM. **Charrin** and **Le Play.**—The tectonic of the massif of the Dent Blanche: Emile **Argand.**—The geology of Iférouane: R. **Chudeau.**

New South Wales.

Royal Society, December 6, 1905.—Mr. H. A. Lenehan, president, in the chair.—A method of separating the clay and sand in clay soils and those rich in organic matter: L. **Cohen.**—Latitude of the Sydney Observatory; appendix to a paper on the provisional determination of astronomical refraction, from observations made with the meridian circle instrument of the Sydney Observatory: C. J. **Merfield.** An alteration in the accepted value ($\phi_0 = -33° \ 51' \ 41''\cdot55$) is regarded as unwise until the question is more completely discussed.—Sociology of some Australian tribes: R. H. **Mathews.** The author stated his opinion that among the social institutions of a primitive people there is none of greater interest and value to the anthropologist than the study of these social systems. He also expressed his conviction that neither "sexual promiscuity" nor "group marriage" has ever existed among the Australian aborigines.—An undescribed species of Leptospermum and its essential oil: R. T. **Baker** and H. G. **Smith.** "The lemon-scented Leptospermum," the species described in this paper, occurs in the north coast district of New South Wales and the southern coast district of Queensland. It is a shrub attaining a height from 6 feet to 12 feet, with erect branches and small, lanceolate, ovate leaves, the flowers occurring in the axils of the leaves on the upper branchlets. The fruits measure about two to three lines in diameter. Its differentiation from described species is based on both morphological and chemical characters, although the former are alone sufficiently marked to warrant its specific rank.

DIARY OF SOCIETIES.

THURSDAY, March 8.

Royal Society, at 4.30.—The Microscopic Changes in the Nervous System in a Case of Chronic Dourine or "Mal de Coït," and Comparison of the Same with Those found in Sleeping Sickness: Dr. F. W. Mott, F.R.S.—On the Relationship between Hæmolysis and Phagocytosis of Red Blood Cells: Dr. R. D. Keith.—Upon the Properties of an Antityphoid Serum obtained from the Goat: Dr. A. Macfadyen.

Royal Institution, at 5.—The Physiology of Plants: F. Darwin, For. Sec. R.S.

Institution of Electrical Engineers, at 8.—A New Single-Phase Commutator Motor: V. A. Fynn.

Mathematical Society, at 5.30.—On Function Sum Theorems connected with the Series $\sum_1^\infty x^n/n^2$: Prof. L. J. Rogers.—On Sommerfeld's Diffraction Problem and on Reflection by a Parabolic Mirror: Prof. H. Lamb.—On Series of Zonal Harmonics: Prof. T. J. I'A. Bromwich.

FRIDAY, March 9.

Royal Institution, at 9.—Some Dietetic Problems: Dr. R. Hutchison.

Physical Society, at 8.—The Velocities of the Ions of Alkali Salt Vapours at High Temperatures: Prof. H. A. Wilson.—Some Experiments on Earth Currents at Kew Observatory: Dr. Harker.

Royal Astronomical Society, at 5.—Preliminary Account of Flash Spectra taken August 30, 1905: Dr. S. A. Mitchell.—Note on Certain Anomalies observed in Radial Velocity Curves: Dr. Alex. W. Roberts.—The Total Solar Eclipse of January 3, 1908: Dr. A. M. W. Downing.—On the Variable Star 38, 1905, RX Andromedæ: A. Stanley Williams.—(1) Discussion of Greenwich Observations of the Sun, 1864–1900: (2) Discussion of Greenwich Observations of Venus, 1869–1900: P. H. Cowell.

Malacological Society, at 8.—Descriptions of twenty-seven Marine Gastropoda, and one Scaphopod, from the Persian Gulf and Gulf of Oman: J. C. Melvill.—Note on *Capulus lissus,* Smith: J. C. Melvill.—Mollusca from a Rainwash, 150 ft. O.D. at Harlton: Rev. R. Ashington Bullen.—Report on a Small Collection of Land and Freshwater Shells from Uganda, with Descriptions of two New Species of Limicolaria and one of Martensia: H. B. Preston.—On New Species of Polyplacophora from South Australia: W. T. Bednall and E. H. V. Matthews.

Institution of Civil Engineers, at 8.—The Design of a Two-hinged Spandrel-Braced Steel Arch: R. Freeman.

SATURDAY, March 10.

Royal Institution, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

MONDAY, March 12.

Royal Geographical Society, at 8.30.—Recent Journeys in the Rhodope Balkans: Colonel F. R. Maunsell, C.M.G.

Society of Arts, at 8.—Fire, Fire Risks, and Fire Extinction: Prof. Vivian B. Lewes.

TUESDAY, March 13.

Royal Institution, at 5.—Food and Nutrition: Prof. W. Stirling.

Institution of Civil Engineers, at 8.—The Widnes and Runcorn Transporter Bridge: J. J. Webster.

THURSDAY, March 15.

Royal Society, at 4.30.—*Probable Papers:* A Discussion of Atmospheric Electric Potential Results at Kew from Selected Days during the Seven Years 1898 to 1904: Dr. C. Chree, F.R.S.—On the Specific Heat of, Heat Flow from, and other Phenomena of, the Working Fluid in the Cylinder of the Internal Combustion Engine: Dugald Clerk.

Chemical Society, at 8.30.—The Interaction of well dried Mixtures of Hydrocarbons and Oxygen: W. A. Bone and G. W. Andrew.—The Explosive Combustion of Hydrocarbons: W. A. Bone and J. Drugman.—The Occurrence of Marsh Gas amongst the Decomposition Products of Certain Nitrogenous Bases as a Source of Error in the Determination of Nitrogen by the Absolute Method: P. Haas.—Studies on Comparative Cryoscopy. Part IV. The Hydrocarbons and their Halogen Derivatives in Phenol Solution: P. W. Robertson.—The Displacement of Acid Radicles. I. Displacement of the Chloride and Nitrate Radicles: A. F. Joseph.

Royal Institution, at 5.—The Physiology of Plants: Francis Darwin, For. Sec. R.S.

Linnean Society, at 8.—Discussion on the Origin of Gymnosperms: Opened by Prof. F. W. Oliver, F.R.S.

Society of Arts, at 4.30.—The Languages of India and the Linguistic Survey: Dr. George A. Grierson.

FRIDAY, March 16.

Royal Institution, at 9.—How to Improve Telephony: W. Duddell.

Institution of Mechanical Engineers, at 8.—*Continued Discussion:* Large Locomotive Boilers. G. J. Churchward.—*Probable Paper:* Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: L. Greaven.

Epidemiological Society, at 8.30.—Evolution in Relation to Disease: Dr. J. T. C. Nash.

CONTENTS.

THURSDAY, MARCH 15, 1906.

TEXT-BOOKS ON PLAIN AND REINFORCED CONCRETE WORK.

(1) *Cements, Limes, and Plasters: their Materials, Manufacture, and Properties.* By E. C. Eckel. Pp. xxxiv+712. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 25s. 6d. net.

(2) *Cement and Concrete.* By L. C. Sabin. Pp. x+507. (London: Archibald Constable and Co., Ltd., 1905.) Price 21s. net.

(3) *A Treatise on Concrete, Plain and Reinforced.* By F. W. Taylor and S. E. Thompson. Pp. xviii+585. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21s. net.

(4) *Reinforced Concrete Construction.* By A. W. Buel and C. S. Hill. Pp. x+434. (London: Archibald Constable and Co., Ltd., 1905.) Price 21s. net.

(5) *Concrete Steel: a Treatise on the Theory and Practice of Reinforced Concrete Construction.* By W. Noble Twelvetrees, M.I.M.E., &c. Pp. xii+218; illustrated. (London: Whittaker and Co., 1905.) Price 6s. net.

(1) THIS book gives an exhaustive account of the various processes involved in the preparation of plasters, limes, and cements, and of the examination of these materials both by chemical and by physical tests. It is probably one of the most complete treatises which has been published up to the present day on this subject, and the author justifies the thoroughness of the treatment by statistics in regard to the monetary value of the cementing material annually produced in Europe and America; in the United States the monetary value of cementing materials increased from 21,773,246 dollars in 1900 to 45,607,436 dollars in 1903.

The author classifies cementing materials under two heads, viz. simple cementing materials, which include all those produced by the expulsion of a liquid or gas through the action of heat from a natural raw material, and the setting properties of which are due to the simple re-absorption of the same liquid or gas, and complex cementing materials, which include those cements the setting properties of which are due to the formation of entirely new chemical compounds during manufacture or use. Plasters are first dealt with in group i.; the process of manufacture is explained, statistics are given as to the total production of gypsum, and details of the chemical and other properties of plasters used in building work; one chapter in this section is devoted to the manufacture and properties of lime-sand bricks, which are made by mixing sand, or gravel, with a relatively small percentage of slaked lime.

As the value of Portland cement annually manufactured in the United States is three-fifths of the total value of the output of cementing materials, it is only natural that a very large portion of the book should be devoted to the questions of the manufacture and testing of Portland cement. The quarrying and other preliminary work necessary in order to obtain the raw materials from which Portland cement is made are dealt with in a series of well written and well illustrated chapters. Then follow details of the preparation of the material for the kilns, and of the best methods to employ in burning the cement and in working the kilns; this is the first text-book on this subject in which we have found a complete and detailed account of the construction and working of the modern rotary kiln. The cementing value of Portland cement depends so largely upon the fineness and character of the grinding that the author rightly devotes much attention to a description of the various grinding machines which have been devised for this work. The last portion of the book is devoted to an account of the physical and chemical tests usually employed in testing Portland cement, and the rules drawn up in 1904 by the American society for testing materials are given in full.

(2) The original investigations which form the basis of this book were made by the author in connection with the construction of the Poe Lock at St. Mary's Falls Canal, Michigan, under the direction of the Corps of Engineers, United States Army. The book is divided into four parts; in the first section a brief account is given of the different cements and limes in ordinary use, and the processes employed in their manufacture; there is a good description of the rotary kilns now often used in making Portland cement.

In part ii. the author deals with the various physical tests usually enforced in examining Portland cement in order to ascertain its quality and its suitability for various purposes, and a series of tables is given of the results of tests made by the author in connection with the works at St. Mary's Falls Canal. In the last chapter of this section the author explains carefully the method adopted at these works for recording the receipt of Portland cement from the manufacturers, the methods adopted for storing it, and for keeping the records of the various tests made from sample barrels selected from each delivery; this chapter will be found very useful as a guidance by any engineer who may have to undertake similar work.

The question of the correct proportion of the various ingredients in concrete, and the methods employed in mixing them, are dealt with in part iii., and a number of tables is given for enabling in any case a determination to be made of the percentage of voids present in broken stone of various classes when broken to varying degrees of fineness; this portion of the book is of an extremely practical nature, and contains a great deal of useful information. The last portion of this section is devoted to the testing of concrete, and the results of a carefully arranged series of tests carried out by the author are given in tabular form. This portion of the book also deals with the question of the determination of the modulus of elasticity of concrete, and with such important points as the

change in volume during the process of setting, resistance to fire, and other matters of a similar nature.

The last section of the book, part iv., is devoted to a description of the various classes of work for which cement concrete is most useful, and the question of reinforced concrete, or concrete-steel, as the author prefers to call it, is taken up. In the last few chapters the methods of applying concrete—both plain and reinforced—in large structures such as subways, arches, reservoirs, retaining walls, dams, &c., are fully explained. The book has a good index.

(3) The whole question of concrete work, both when used by itself and when employed in combination with steel, or reinforced concrete, as it is technically known, is fully dealt with in this elaborate treatise. The first portion of the book is devoted to the properties of Portland and other cements, and includes an interesting chapter which deals with the chemistry of hydraulic cements, and which has been specially written for the book by a chemist, Mr. S. B. Newberry. The authors then deal with the question of the ordinary standard tests of Portland cement, and quote the recommendations of the French Commission of 1893, and of the special committee of the American Society of Civil Engineers, appointed in 1904. There are a number of first-rate illustrations of the various appliances which are needed, and full explanations are given as to the best way of carrying out these standard tests. In addition to the standard tests, special tests, such as those on compression, adhesion, &c., are also discussed. This portion of the book will be found extremely useful for reference purposes.

Two chapters deal with the questions of the method of determining the laws of volumes and voids in concrete work, and the right methods of proportioning the ingredients used in making are explained in detail. The methods described may seem almost too elaborate, but there is no doubt that it pays well when concrete is to be used on a large scale to spend a considerable amount of time and trouble beforehand in determining exactly the best possible mixtures of cement, sand, and broken stone in order to produce the most economical as well as the strongest concrete suitable for the work which has to be carried out.

The authors then begin the subject of reinforced concrete, and, after discussing the values which should be used for the moduli of elasticity of concrete, both in tension and compression, go on to deal with the problem of the moment of resistance of a reinforced beam. The formulæ obtained are fairly simple, and may be said to be approximately correct, since the neglect of the tensile stress taken up by the concrete is perfectly reasonable in designing such beams. It appears to us very inadvisable in our present state of knowledge to attempt to use extremely elaborate formulæ in calculating the strength of reinforced beams, since the values obtained by different experimenters, and even by the same experimenter, for the moduli of elasticity of concrete differ by such large amounts, and the assumption that the stress-strain diagram is a parabolic curve seems to us quite unwarranted by the experimental data available up to the present time.

The authors then give some convenient tables for use in the calculation of the strength of beams and slabs which are continuous over supports, and work out a number of examples to illustrate the use of these tables. In dealing with the mixing of concrete, a number of illustrations is given of the various types of mechanical mixers now used when concrete has to be made on a large scale, including mixers fitted with automatic measuring plants in order to keep the proportions of the various materials absolutely uniform. A special chapter in this section has been written for the book by Mr. R. Feret upon the effect of sea-water upon concrete.

A few chapters then follow on the question of the effect of frost upon concrete, both during the time of depositing the concrete and after the concrete has been deposited, upon the necessary proportions of the various ingredients in order to secure absolute water-tightness in any given mass of concrete, and upon the protection afforded to iron and steel when used in reinforced concrete against fire and rust. The remaining chapters of the book are devoted to details of concrete work in various situations, such as sidewalks of streets, floors and walls of buildings, foundations and piers for bridges, retaining walls, sewers, subways, arches, reservoirs, and tanks, and the most economical method of strengthening such concrete by steel reinforcements. A very good bibliography of the subject, and some appendices dealing with the formulæ for the strength of beams, conclude a very valuable book.

(4) This is a treatise for engineers engaged in the design and construction of works in reinforced concrete, and is based mainly on American practice. The book is divided into three parts; in part i., for which Mr. Buel is responsible, after a brief explanation of the properties of cement concrete and steel, the methods of calculation are dealt with; simple formulæ are deduced for the strength of beams, both for the case when the tensile strength of the concrete is taken into account, and when it is neglected; the more important of the empirical formulæ, such as those due to Thacher, Christophe, and Hatt, are then explained, and two very complete tables are given for the safe loads in reinforced slabs of various spans, based on Thacher's formula.

The design of reinforced columns is then discussed, and the author by a series of tables shows how closely the strengths of such columns, deduced from the formulæ he gives, agree with the actual crushing strengths obtained in a series of tests at the Massachusetts Institute of Technology. The application of this system of construction to retaining walls, dams, sewers, &c., is very fully explained, several neat graphical constructions being given; and in this chapter the author deals with the very important problem of the use of steel reinforcement to prevent the cracks liable to occur in large concrete structures, such as dams and retaining walls, due both to shrinkage in setting and to thermal stresses, and he is of opinion that high carbon steel is more economical for this purpose.

In the last chapter of this section the testing and

design of reinforced concrete arches are taken up; after a brief explanation of the elastic theory and its application to the determination of the stresses in any arch, Thacher's formulæ for reinforced concrete arches are given, and their use in practice explained by the help of three typical examples of such arches, a highway bridge of two spans, each of $42\frac{1}{2}$ feet, a single-line railway bridge of 72-feet span, and, lastly, a small semicircular arch culvert of 15 feet span. These three examples are completely worked out, the necessary graphical constructions being shown in full in three plates; this chapter will undoubtedly be found very useful to any engineer who is engaged in the design of such arches.

Parts ii. and iii. are the work of Mr. Hill, and deal respectively with representative structures and methods of construction; the following branches of work are dealt with:—foundations of various types, including reinforced concrete piles, floors, walls and arches in buildings, and columns. The illustrations selected, though largely American, include also a number of cases of work carried out in Europe on the Hennebique system. The application of reinforced concrete to large bridges and culverts is illustrated by a number of structures which have recently been put up in France on the Monier system, and it may be pointed out that some hundreds of bridges of this type have now been erected, principally in Germany and Austria.

The last section of the book, on methods of construction, is naturally largely taken up with the description of the various forms necessary in elaborate reinforced concrete work. The future security of the work depends entirely upon the care with which the forms are designed and erected, and the economy of the work is largely dependent upon forms so designed that they can be rapidly put into position, readily taken down, and readily re-erected on a fresh section of the work. Many valuable hints and labour-saving suggestions will be found in this portion of the book. The author has evidently based this section upon experience of a very varied character in the erection of reinforced concrete structures.

(5) This is another of the somewhat numerous text-books which have appeared within the last few months dealing with the important subject of reinforced concrete. The author points out that the use of steel merely embedded in stone or concrete, as in the well known skeleton system of construction, does not develop the best properties of each of these materials—reinforced concrete alone enables full advantage to be taken of the special qualities of both the steel and the concrete.

The first portion of the book deals with the physical properties of the two materials, concrete and steel, and a number of carefully selected tables is given of tests of these materials. The general theory of concrete-steel beams is then considered, and special emphasis is laid upon the necessity of an accurate knowledge of the moduli of elasticity.

We are afraid, however, that the author has fallen into confusion of thought in discussing the question of the position of the neutral axis; on p. 43 he refers to an imaginary beam of concrete and steel, and appears to consider that each square inch of the concrete will carry the same total stress, ignoring altogether the variation in intensity of stress with distance from the neutral axis; and again, in chapter iv., when discussing the position of the neutral axis, he states that the position of this is affected by the fact that the compressive strength of the material (concrete) is greater than its tensile strength. Surely there is confusion here between strength and modulus of elasticity, and this confusion seems to run through all the rules and calculations for the position of the neutral axis. This portion of the book certainly requires to be carefully revised if it is to become a trustworthy text-book on the subject.

The subject of floor design in concrete and steel is taken up, several large floors constructed on the Hennebique system are fully described, and tables are given of working stresses which can be allowed, and the building rules which have been laid down by various authorities in connection with the design of such floors. The application of reinforced concrete to foundation work in bad soils is discussed, and the author shows that by the use of this type of construction the depth to which the foundation must be taken can be very considerably reduced. The last chapter discusses the construction of reinforced concrete columns, special attention being given to Considère's hooping method.

CHEMISTRY FOR SCHOOLS.

Notes on Volumetric Analysis. By J. B. Russell and A. H. Bell. Pp. viii+94. (London: John Murray.) Price 2*s.*

Introduction to Chemical Analysis. By Hugh C. H. Candy. Pp. xii+114. (London: J. and A. Churchill, 1905.) Price 3*s.* 6*d.* net.

An Elementary Text-book of Inorganic Chemistry. By R. L. Whiteley. Pp. viii+245. (London: Methuen and Co.) Price 2*s.* 6*d.*

Elementary Chemistry, Progressive Lessons in. By F. R. L. Wilson and G. W. Hedley. Pp. xii+168. (Oxford: The Clarendon Press, 1905.) Price 3*s.*

A Three Years' Course of Practical Chemistry. By George H. Martin and Ellis Jones. Pp. viii+112. (London: Rivingtons, 1906.) Price 2*s.*

IT seems to have become a recognised practice for schools and colleges to produce their own small text-books or notes on some portion of the science curriculum, first for internal use, and then for the benefit of outsiders. Whether this multiplication of little books is desirable is somewhat questionable. Without going so far as to say that these small books conduce to cramming or getting through examinations, there is always a slight lurking suspicion about this point. Our various "examination" boards are perhaps answerable for the small book production.

Mr. Russell's book is intended, no doubt, for use on the working bench. The directions for working are short, mainly to the point and in logical order, but surely they are too frequently repeated.

After about twelve pages of instructions and examples on the use of permanganate, the student is still told to weigh out so much ferrous salt, make up to so much, &c.; little room is left for the student to think and find out for himself.

After the idea of "normal solution" has been once grasped, many of the directions might be left out. One somewhat objectionable point noted is the direction to weigh out a certain definite quantity of a substance, say 5.3 grams. This is not an easy matter for beginners. It is better to take a weighed quantity and make up solution to the desired strength by addition of the calculated proportion of water.

The ground covered ranges from acid and alkali through permanganate to silver and thiosulphate, preceded by a good description of the use of the burette, &c. The book will no doubt be useful, especially with large classes where the instructor is not able to get rapidly around to the students.

The preface of Mr. Candy's book informs us that the methods and processes of analysis and synthesis have been chosen to meet the requirements of students preparing for parts i. and ii. of the preliminary scientific examination in the University of London and the first examination of the joint board. After a sensible introduction, chapters follow on the identification of bases and acids, methods of separation and tests of purity, and a very useful chapter on preparations. In the latter section are included examples of preparations of mineral salts, acids, esters, alcohol derivatives, &c. The processes of taking a melting point and a boiling point might have been illustrated by a sketch. The preparation method for aldehyde is somewhat dangerous in inexperienced hands. It is safer to drop alcohol, very slowly, into the warm bichromate mixture and distil off the aldehyde as fast as formed. Some short chapters on equivalent and volumetric operations complete the book. The matter is clearly expressed, and the book will be useful for the class of students for whom it is intended.

The first forty-two pages of Mr. Whiteley's book deal with physical changes and physical properties. The book is rather freely illustrated by diagrams of apparatus, and the descriptions and explanations are generally quite clear, full, and understandable. It is designed for the use of those studying elementary chemistry on the lines of the Board of Education syllabus. The purely chemical sections include air, water, common salt, chemical theories, compounds of nitrogen, carbon and sulphur. There are appendices on solubilities of salts, questions and answers to calculations. The book should be very useful, especially to students unable to attend courses of experimental teaching or lectures.

The volume by Messrs. Wilson and Hedley is intended as a school course for beginners. It is entitled "Elementary Chemistry," but a large part of the book is concerned with necessary matters of elementary physics, such as measuring, length, areas, volume, the thermometer, density, solution, evaporation and boiling, Boyle's law, &c. The book is simply and clearly written, and illustrated by useful diagrams. Strictly speaking, there is no chemistry in the book, but we think all boys intending to commence that subject would benefit exceedingly by working through the excellent course here given.

The plan of instruction set forth by Messrs. Martin and Jones is to perform some experiments on a given substance such as mixing "salammoniac with quicklime and heating in a test tube." The inquiring student is then required to write out an account of what he notices, and to compare the results with those obtained when one of the substances is heated alone. Commenced with moderately young students who have not the bogey of an examination paper, or a particular syllabus, throwing a baleful shadow over them, this plan should produce excellent results. The book could scarcely be used to full advantage by students working alone, but with a sympathetic teacher at hand to fill in necessary explanations we think the volume a valuable addition to the host of books already available.

W. R. H.

CERTAIN MODERN VIEWS ON PATHOLOGY

Introduction à la Pathologie générale. By M. Félix le Dantec. Pp. x+504. (Paris: Félix Alcan, 1906.) Price 15 francs.

IN this work the author has grouped together a large and heterogeneous mass of information and speculation, always interesting and always fascinating. The first line of his introductory remarks leads us from the tubercle bacillus to the Milky Way, from the infinitely small to the immeasurably large, and we are soon assured that everything that exists in this formidable interval of space can be subject to investigation, provided it, in any way, can influence us. This promise holds good for everything, from an earthquake on the satellite of Sirius to an analogous occurrence in the interior of an electron; and so on, until after forty pages of pleasant reading we learn that the object of the book is principally to support the views of M. Bordet "and some others" as to the question of immunity. The theories of Ehrlich and his followers give a purely chemical interpretation of the facts of immunity, and are unsatisfactory inasmuch as they confound colloidal changes with chemical changes, properly so called. Ehrlich's views, he says, threaten to become to general pathology what Weismann's have been to biology.

> "It is always dangerous to give names to things which do not exist—this is to create entities, of which it will afterwards be found extremely difficult to disembarrass oneself."

The author divides his book into two great sections. In the first he desires to advance slowly, to return frequently to the same subjects, so as not to come into too violent collision with the habit of thought of those who have for a long time been familiarised with the language of chemistry; also to give a short account of such of the properties of colloids as may be of interest to the biologist, and to sketch the main lines of the physical theory of serotherapy. Thus he leads the reader to the "notion" of the three heredities, chemical, physical, and symbiotic heredity. The

first part concludes with certain considerations as to the influence of radiations on the equilibrium of living substances.

In the second division of the work the author proceeds to render more precise the language prepared in the first part of his study. He reviews the more important types of infection, and particularly considers intracellular parasitism and symbiosis; then he passes on to the phagocytic studies of M. Metchnikoff, and uses a language different from the vitalistic expressions of the great Russian *savant*. Next comes the considerations of the comportment of the living organism towards injections of dead colloids, thus leading up to the study of infection proper, *i.e.* disease due to living micro-organisms. The above abstracts will suffice to show the aim of the author's book, and chiefly he desires to use "*the language of equilibrium*," language borrowed from physical chemistry. He holds the law of Le Châtelier valid for the modification which an organism undergoes when it triumphs over infection. "The modification produced in a system of bodies in a state of equilibrium by a variation of one of the factors in the equilibrium is of such a nature that it tends to oppose itself to the variation that determines it." His position is even more clearly defined on p. 184, where he says that he wishes to show that if the immunities that result from the resistance of organisms to infection resemble the phenomena of physical chemistry, the resemblance is exclusively on the physical side. He finds that questions on immunity and serotherapy are discussed in the language of chemistry, even by those investigators who do not accept the theories of Ehrlich—therefore the very words used are filled with unjustifiable hypotheses, and give an inflexible interpretation to phenomena. For example, the partisans of the chemical theory of serums admit the existence of two definite and complementary substances, "cytase" and "fixative," the former thermolabile, the latter thermostable, and these thermic relations, according to M. le Dantec, suggest that these substances—even if chemically definite bodies—act in virtue of their *physical* character rather than in accordance with their *chemical* structure.

The phenomena of bacteriolysis receive at the hands of Ehrlich a purely chemical interpretation; M. le Dantec deliberately states that the chief fault in Ehrlich's theory is that the serum-producing animal must have an immediate and profound knowledge of chemistry. This can scarcely be seriously meant.

Nowhere does he give a complete account of the views on immunity and toxins held by Ehrlich, nor is this to be looked upon as a fault, inasmuch as those of Ehrlich's opinions that he does consider he regards as entirely untenable. Still, this omission (if such it be) shows that the book will be of little use to a student really needing an introduction to general pathology, however interesting and instructive the work may be to the thoroughly equipped investigator; and to the latter the learned author doubtless addresses himself. First and foremost he is a biologist, and, moreover, is imbued with the belief that pathology is capable of throwing a flood of light on biological questions.

Many pages of the work remind us of the author's well known papers in the Annals of the Pasteur Institute, and these pages will be read by many with reminiscent pleasure.

Nowhere is the author more interesting and lucid than in his discussion of Mendelian or discontinuous heredity; his quotations are apt and instructive; his own remarks carry with them the imprint of careful study and original thought. In this connection he replaces the "*representative particles*" of Darwin and Weismann by the Pasteurian word "*microbe*" meaning thereby *particles productive of diatheses*—and claims that by so doing he loses nothing in the narration of the facts, while gaining the advantage of placing the diatheses (characters of Mendelian heredity) apart from the characters of heredity properly so-called.

The book is well worth careful reading, and the author is to be congratulated on a work which will challenge the attention of the more advanced students of pathology. WM. ST. C. SYMMERS.

OUR BOOK SHELF.

Die optischen Instrumente. By Dr. Moritz von Rohr. Pp. v+130. (Leipzig: B. G. Teubner, 1906.)

THE aim of this little book, one of a series dealing popularly with various subjects of scientific or general interest, is to give a simple account of the development and modern theory of optical instruments, and to make clear to readers possessing no special technical knowledge the main features of their optical construction. The treatment is largely based on the work of Abbe; and in the introductory chapters, which deal with the general principles governing the formation of optical images and the consequences dependent on the characteristics of the eye, special attention is given to the question of aperture and the limits of the image-forming pencils, and to the manner in which the perspective of a picture may be modified in the image. In the application of these considerations to the photographic lens, the microscope, and the telescope, there is some novelty and interest. In other respects a clear and concise account is given of the main properties and aberrations of the different instruments, whether for objective or subjective use, with some brief historical notes. The section on the photographic lens is followed by useful particulars as to enlarging and projection apparatus; the description of the microscope includes a short explanation of Abbe's theory of microscopic vision, of the relation of "numerical aperture" to resolving power, and of the sine law, and even admits of reference to the possibilities of photomicrography with ultra-violet light. To the description of the ordinary forms of telescope are added some notes on the prism binocular as constructed by the Zeiss firm. The diagrams and illustrations are noticeably well drawn and clearly printed.

Second Year Chemistry, a Handbook for Laboratory and Class Work. By Prof. Edward Hart. Pp. vi+165. (Easton, Pa.: The Chemical Publishing Co., 1905.) Price 1.25 dollars.

THE plan of this book is to begin, after a few theoretical generalities, with some careful quantitative determinations. Thereupon follow qualitative analysis, chemical arithmetic, and, finally, more quanti-

itative analysis. The treatment is marked throughout by a considerable degree of originality, and the book appears agreeably free from the domination of an examination syllabus or of the authority of any particular school. It is unusual to find the determination of silicon in pig-iron or steel in an elementary book, and so also the use of a Hempel gas apparatus; but there is, after all, no good reason why the practical work of elementary students should not be interspersed with exercises of this more technical kind. It is astonishing what sanctity is still attached to the established order of practical chemistry, and it is not the least interesting feature of this book that it is markedly unorthodox. Most teachers will admit that they may profit by carefully inspecting the plans of instruction adopted by their well accredited colleagues, and such a remark may certainly be made of Prof. Hart's little book. A. S.

La Nature et la Vie. By Henry de Varigny. Pp. ii+356. (Paris: Armand Colin, 1905.) Price 3.50 francs.

In a pleasant and easy fashion the writer of this book carries the reader from the beginnings of life to its termination by death. The origin of life on this planet, the vital phenomena of the lower and higher forms of vegetable and animal life, the part played by bacteria in the fertilisation of the soil, the evolution of living forms, parasitism, the multiplication of animals and plants, the beginning of the end, the problem of death, and the immortality of the protozoa are a few of the subjects dealt with. The book may be recommended as a good popular introduction for the educated but non-scientific reader to general biological problems.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Plea for Absolute Motion.

NEWTON believed in the possibility of absolute motion (*i.e.* motion in space not necessarily relative to other material bodies), founding his argument on the fact that the rotation of a planet might be detected by experiment on the planet itself without reference to outside bodies. Newton's reasoning is unanswerable, but it only takes us part of the way. Though it proves that using the principle of gyrostatic action we can determine direction in space absolutely, it fails to distinguish one parallel line from another. We can only observe relative motion. This statement, which no one doubts, is generally taken to be synonymous with the assertion that nothing but relative motion will ever be known. So firmly is this generalisation rooted in the present generation of philosophers that I am afraid the expression of a contrary opinion will only result in placing its author on the "Index" of De Morgan's Budget of Paradoxes.

It is therefore with considerable hesitation that I venture to raise the question whether we are not most of us in our innermost hearts believers in absolute motion, and whether a good deal of the persistence with which we try in our lectures to prove that no meaning can be assigned to absolute motion does not arise out of the desire to repress our own rebellious doubts. As regards the direct evidence of observation we are all agreed, but if from the outset we limit the results of reasoning to that which may directly be controlled by experiment, we must throw overboard a good many theories which are firmly believed in by men of science. I will try to show that it is almost impossible to exclude the idea of absolute motion from our discussions, and that some of our scientific definitions tacitly admit it.

The observed motion of the solar system through the stellar universe has frequently been introduced into the discussion of relative motion, but I do not think that its full importance has been recognised. The thesis I wish to maintain is that the question whether our solar system possesses velocity not only relatively to the stellar universe, but absolutely in space, constitutes a definite problem to which a scientific meaning can be attached. It is immaterial to my purpose whether our present observations are sufficient to allow us to draw any definite conclusions. If the validity of the question itself is admitted, my point is gained.

In order to free the main issue from the uncertainties arising out of the imperfections of our observations, I will base my argument on an ideal condition of the universe which resembles the real universe sufficiently to be admitted as a possibility. The displacement of a star relative to the solar system may be determined in two ways. While telescopic observations give us the angular motion in a plane at right angles to the line of sight, spectroscopic observations allow us to determine radial velocities. To determine velocities by means of the telescope we require to know the distance of the stars, but the determination of parallax is a question of instrumental perfection and of long-continued observation. We commit, therefore, no error in principle if we imagine the parallaxes of the stars in our ideal universe to be known, so that the combination of telescopic and spectroscopic observations can determine the relative velocity in magnitude and direction.

It is a matter of history that telescopic observations alone have led to the conclusion that the solar system moves relatively to the stellar system towards a point which, as fixed by Prof. Newcomb's discussion, has a right ascension of 277°·5 and a declination of 35°. Taking this point as apex, Prof. Campbell divided the heavens into eighteen zones, obtained by drawing circles of latitude at a distance of 10° with the apex as pole. In every one of the zones which had a smaller apical distance than 90°, the average motion was one of approach to the sun, and in every one of the zones having an apical distance greater than 90° the motion was one of recession from the sun. A complete discussion gave for the line of direction, as obtained by the spectroscopic method, R.A. 277°·5, dec. 20°, the right ascension agreeing exactly with the value deduced by Newcomb, though the declination differs materially. The relative velocity found was about 20 kilometres per second.

We may now idealise this observed universe so as to simplify the argument, and bring out its essential points. Divide the heavens into a number of compartments. Let in each compartment the relative velocities be measured for a large number of stars combining the spectroscopic and telescopic method. Let u be the average velocity of each group relatively to the solar system, so that the velocity of each star in the group can be represented by $u+v$, both quantities being vectors. For the sake of argument, assume that u is the same for all groups, and that v within each group is distributed according to the law of errors. As regards v, there is no predominance of any direction (otherwise u would be affected), and its magnitude will be distributed about its mean value in a manner which we will take to be the same for all groups. The question arises: How should we interpret such observations if the facts were as stated?

It is not sufficient to say that the observations would prove a relative motion $-u$ of the sun with respect to the stellar system, for this would only represent a small part of the facts. The important point brought out by the observations is that the relative motion is observed to be the same for the mean point in each one of a great number of groups of stars. The fact that within each group the distribution follows the law of errors leads to the conclusion that the groups are independent systems, and I put the question thus: Does it require an explanation why all these independent systems should have the same vector u imposed upon them? If you admit the validity of this question, if you begin even to discuss the alternative explanation that the vector u reversed really belongs to the solar system, and indicates its velocity, you have practically surrendered to absolute motion. If there were only one star in existence showing relative motion towards the

solar system, and someone were to begin to ask: Is it the star that moves or ourselves? we should at once reject the question as absurd, and say that the two alternatives mean the same thing. But I doubt whether there will be many who would be satisfied to contemplate a stellar universe, each member of which has the same relative velocity with respect to the sun, without feeling that here is a problem which requires investigation.

The ideal case considered might be realised if we could imagine observations to be taken from a molecule in a mass of gas enclosed in a box, the observations being taken in the interval between two collisions. If other molecules could be brought within the range of observation, we should, indeed, find that for the mean point in each group containing a large number of molecules the observed relative motion has the same value, that value being the reversed velocity of the molecule itself. If there were any ordinary common-sense philosopher placed on the molecule, he would argue that his observations have really determined the absolute velocity of his place of abode in space, but his wiser colleagues will tell him that he is wrong, and that he has only determined his velocity relative to the rest of the system. The common-sense philosopher would then justly claim that he has done more than that, and point out that the whole system of molecules can be divided into a great many groups, and that the relative velocity in all the groups is identical in magnitude and direction. With our greater knowledge from outside, we know that the velocity which has been determined really belongs to the molecule, and we should probably add (though this is not a matter which the supposed observations could have proved) that it is the velocity relative to the vessel which contains the gas. But even then not all the facts which the observer on the molecule has discovered are accounted for. If the gas could be set into violent motion, without altering the velocity of the particular molecule from which the observations are made, the observer would still obtain the same value for his relative motion, but the different groups into which he has divided his space would no longer give identical values. The complete conclusion to be drawn from the original observations is, that a velocity has been determined relative to an outside body which is mechanically connected with the system, and that each group of molecules is separately at rest relatively to this outside body.

Consider now the application of this example to our problem. If we could argue by analogy we should conclude that the observed velocity of the solar system really belongs to it, and not to the stars, but that it must be taken as relative to something which is outside the stellar universe, though connected with it. If that something is material, we should be forced to the conclusion that we have determined a velocity relative to a material body which has not come into our range of observations at all. The conclusion seems too absurd to be entertained. The only alternative is to replace what in the case of the gas was the containing vessel by something immaterial, which therefore we cannot imagine to be in motion. Not being capable of motion it must be at absolute rest, and we may identify it with that abstraction to which we give the name of space. All motion relative to space is absolute motion.

It may be said that if this argument is to be applied to the actual universe, I have left out of account a large number of bodies of which we have no cognisance because they are not luminous. It is possible that these obscure bodies would, if we could observe them, show a systematic motion which would quite upset the previous conclusions. To this I reply that I have treated an ideal case which may or may not coincide with the actual one. I have expressed no opinion as to whether, on the strength of present observations, we are justified in assigning absolute velocity to the solar system; but it may be pointed out that almost every theory which we now believe to be true may some day be upset by facts at present undiscovered, which cannot be reconciled with it. Should we come to the conclusion that our solar system is in motion we may have to modify that belief in the future, but this possibility does not prevent our being justified in adopting views which are in accordance with the facts at present known.

There is an easy way out of the difficulty. When we are driven to our wits' end we have recourse to the æther. Why, then, assume absolute motion when it is so simple to say that you have determined the motion relative to the æther? We should by this device be able to calm our consciences as regards relative motion, no doubt, but at the expense of logical consistency. A moment's reflection will show that the æther has nothing to do with the question. If the æther were non-existent and the corpuscular theory of light were true, the displacement at right angles to the line of sight would still be observed, and as regards the radial velocities the contemplation of the corresponding acoustical problem is decisive. The note of the whistle of an approaching engine is quite independent of the direction of the wind. Similarly, the observed Doppler effect when the spectra of stars are examined is independent of any uniform drift there might be in the æther. No doubt we may, and probably must, consider the æther as immovable in space, and in that case absolute motion in space becomes identical with motion relative to the æther; but the direct conclusion derived from the observation of stars applies to space, and not to the æther.

All our observations of position can only be relative to some standard point. Motion involves change of position, hence motion can be relative only. This is the main argument on which the impossibility of absolute motion is founded. But it proves only that *observed* velocity must be relative, and not that there is nothing real corresponding to absolute velocity. The argument also assumes the very doubtful proposition that velocity must be derived from change of position. It may be the other way round, velocity may be the more fundamental thing, and change of position may have to be derived from it. It seems to be equally logical to take $s=\int vdt$ or $v=ds/dt$ as the equation representing the relationship between the position and velocity. Indeed, if we read Poincaré's description of how we form our ideas of space, we must be struck by the importance attached to the muscular sensation which accompanies a change of position of our bodies. To quote only one of his sentences:—"None of our sensations could have led us by themselves to the conception of space. We are led to this conception only by studying the laws according to which our sensations succeed each other." Bearing this in mind, it seems rational to start from the idea of velocity as rate of change of position, and deduce the idea of position from it. Rest would become an abstraction, and would have to be defined as an infinitely small motion.

There is, however, another way of looking at it. It is known that it is much more difficult to convince ourselves of the objective nature of time than of space or velocity. In fact, I believe most metaphysicians now would deny the objective nature of time altogether. It might therefore be useful to accept both position and velocity as fundamental conceptions, and deduce time intervals from them. In any case, sufficient has been said to show that the practical definition of relative motion cannot in itself be taken to prove that absolute motion is an impossible conception.

If I suggested at the outset of this discussion that most of us have all along been secret believers in absolute motion, I was led to that belief partly by the manner in which the problem of solar motion in space has always been treated. Those who have drawn the logical conclusion from the observations have not infrequently guarded themselves by some statement that after all it is only relative motion they are trying to prove. But their discussion nearly always tacitly assumes, not relative, but absolute motion, and I think most astronomers and physicists, if taken unawares, would admit the absolute motion of the solar system in space as a proved fact, though on second thoughts they might try to explain it away by motion relative to the æther or by some other expedient invented *ad hoc* to safeguard their true faith in relative motion.

But a tacit assumption of absolute motion is also included in the definition of force which at present is much in favour. "Force is rate of change of momentum." If velocity is relative, momentum is relative also. The above definition is therefore incomplete, and may be misleading unless it is definitely stated what the standard system is relative to which momentum has to be measured. Even

quite apart from the earth's rotation the force of gravity impelling a body to the ground is not correctly measured by the rate of change of momentum relative to the earth. Though the neglect of the mass of the body itself, compared with that of the earth, may not lead to serious contradictions in this particular instance, the definition is wrong in principle unless absolute momentum be meant, or unless it be specified that the momentum has to be taken relative to some body unacted on by any forces.

For our definition of force we shall have to return to Newton, and I may have to trouble you with a further communication to justify my belief that though modern criticism has been able to point out the weak spots of the Newtonian system, it has failed to substitute any more secure or more logical basis for our foundation of mechanics.

Arthur Schuster.

The Diffusion of Solids.

In view of the interest attaching to the vaporisation and diffusion of solids, the following observations may be worthy of record.

On the inside of the case of a silver watch between forty and fifty years old, and opposite the steel pin of the key-hole, a diffused, dark patch, larger than the key-hole itself, was noticed. When a drop of strong hydrochloric acid was placed on the spot, bubbles of gas were evolved, and the colour gradually became lighter, though after ten minutes, when action had apparently ceased, the patch was still plainly marked. On adding a drop of potassium ferrocyanide solution the blue precipitate due to iron was formed. Similar results have been obtained with other old watches. Since it was shown that the iron was not in contact with the silver, the facts indicate that the iron, or possibly some compounds of iron contained in it, vaporises, dissolves in the silver, and penetrates for some distance into the latter by diffusion.

Prof. F. D. Brown has observed an effect of similar nature. On a porcelain writing tablet were notes written in blacklead perhaps forty years ago. While recent writing is easily removed, these marks can no longer be defaced in any way by washing or mere surface scratching, showing that the carbon has penetrated into the porcelain no inconsiderable distance. That this should have taken place in the case of two such refractory solids as carbon and porcelain is all the more remarkable.

John H. Howell.

Grammar School, Auckland, N.Z., February 4.

Earth Tremors in India.

In connection with the short description of the Kangra earthquake, and the reference to the still greater earthquake of 1897, contained in Nature of March 1, p. 418, it may be of interest to note that, at a distance of about twelve miles from the point that was supposed to be the centre of greatest disturbance in the latter earthquake, tremors were still appreciable, at frequent intervals, in the early part of 1904.

While we were sitting on the verandah of the Government bungalow at Rongmudu, in the Garo Hills, near the point at which the river Somersary changes the direction of its flow from east to south, in the early afternoon of February 10, 1904, my travelling companion, Mr. A. B. Nowell, of Dwarra, Sylhêt, directed my attention to a booming sound like the beating of distant gongs, and at the same time pointed to a glass of water standing on the table in front of us, in which the water was distinctly agitated. The tremor lasted for only ten or fifteen seconds.

Mr. Nowell, who had spent some months of each year in that neighbourhood for several years in succession, informed me that tremors occurred at frequent intervals every day when he first came there, but were getting fainter and less frequent as time went on. Later in the same day he directed my attention to another tremor, but as we were then walking in the jungle I failed to appreciate it. On the following day we travelled many miles southwards, or away from the centre of disturbance, so that I had no further opportunity of observing these phenomena.

W. Galloway.

Peculiar Ice Formation.

I should like to direct attention to a peculiar ice formation which I have noticed during the last week on the moorland area at this place, and I should be glad to know if this phenomenon has been observed elsewhere.

The moorland here is of considerable extent, and at a height of 1000 feet above the sea level. The rocks on the upper surface are of a brittle shale with outcropping sandstone, and on the lower slopes beds of clay and gravel. On March 2 I noticed the surface of the ground for distances of a hundred yards or more raised to a height of from 1 to 2 inches, and supported by ice pillars, which had evidently grown by addition of water from below the surface. The sensation of walking on these patches was somewhat analogous to that observed when walking upon a good pile carpet. The late snows had all melted, but the surface contained much moisture, and there had been a certain amount of frost the previous night. The time was 9.30 a.m., and as I stood there these ice pillars crackled and fell in such order as to give the surface a honeycombed appearance.

I found on examination all the talus slopes in the gullies of the moorland to be covered with the same ice structure. These ice pillars were not very evident until some of the earth had been cleared away, as a thin layer of earth was held up in a very uniform manner on the top of them. I found them perpendicular to the surface, both on the pathway and upon the inclined surfaces in the gullies. Several hours afterwards, when the heat of the sun's rays had melted the ice pillars, the whole surface presented a honeycombed appearance. I only noticed this to have taken place in those areas void of any vegetation whatever, and where the heat would be quickly radiated into the atmosphere. The whole of these areas is now broken up into a very fine titrated soil; if this tendency to superficial vertical ice thrust is at all general, it appears to me to be a great factor in the disintegration of surface soils.

James Foulds.

Darwen, Lancashire, March 5.

Cooperation between Scientific Libraries.

In connection with the discussion raised by the note on Dr. Muir's paper (p. 372) and Dr. Bather's letter, it may be of interest to note that the Royal Irish Academy, some five years ago, prepared a classified card-catalogue of the scientific serials accessible in various libraries in Dublin, and it is proposed to keep this up to date through the cooperation of the various librarians. This catalogue is always ready for reference by any member or visitor in the academy's reading-room; and it has been of late years the custom for the library committees of various Dublin institutions to inquire, when a new periodical is proposed, as to its possible previous inclusion in one of the other libraries.

Grenville A. J. Cole.

March 10.

Sounding Stones.

With regard to Mr. Tingle's letter in Nature of January 4 (p. 222) on sounding stones, it may interest you to know that I have just seen at Pagan, the former capital of Burma, now in ruins, a large log of fossil (or rather silicified) wood, used as a gong. It emits a clear ringing note when struck, and is used, like all pagoda bells or gongs, to direct the attention of the guardian spirits to the offering about to be presented by the pious Buddhist.

O. F. Wheeler Cuffe.

Meiktila Upper Burma, February 11.

An Inquiry for Books.

Can any reader of Nature direct me to English books on the history of Arabic literature, history of Arabic education, and general sanitation?

G. Hammâm.

Oriental College, Zahleh, Beirût, Syria, February 24.

A NEW COUNTY BIRD-BOOK.[1]

A BOOK on the birds of Hampshire and the Isle of Wight fills up a blank in the list of English county avifaunas, and is a particularly interesting instalment of the series. Few, if any, districts in Great Britain surpass this in the attractions it possesses for the field naturalist, its natural features presenting a greater variety than is usually to be found in an area of similar limitations, large though this county is. If it boasted of nothing more than the far-famed New Forest, the happy hunting-ground of so many naturalists, Hampshire would furnish material for a good bird-book. But in addition to its woodlands it embraces open downland and hills, cultivated country and a varied coast-line including the muddy estuaries and harbours of the mainland and the famous cliffs of the "Island." It is not, therefore, surprising to find the district credited with a list of 127 resident birds and summer visitors, which remain to breed, in addition to 70 winter visitors, 36 occasional visitors, and 61 species of so rare occurrence that the authors are obliged to attribute their appearance to accident. With regard to the occurrence of rare visitors on migration, the authors point out that the lighthouses and vessels (to which are due the discovery of so many waifs) on this coast are not good stations for observation.

Hampshire has not been less fortunate in her naturalists and her natural historians than in her natural features. From the days of Gilbert White onwards the birds of Hampshire have been studied and loved by many notable people. Hardly less known than the "Natural History of Selborne," we have the immortal "Instructions to Young Sportsmen" of Colonel Peter Hawker, and his more recently published "Diary"; Gilpin's "Forest Scenery" and Wise's "History of the New Forest." These, added to the writings on local birds of the Rev. C. Bury, Captain Henry Hadfield, Prof. T. Bell, Mr. A. G. More, the Rev. Richard Warner, Mr. G. B. Corbin, Mr. E. G. B. Meade-Waldo, and others, have furnished the authors with a wealth of material stretching back to a time when little attention was paid to ornithology. But besides these more pronounced naturalists, famous men of letters, and women, too, have made some mention of Hampshire birds—Kingsley and Tennyson, and Jane Austen and Charlotte Yonge—while the modern maker of books has not left them alone.

In collections, too, the county is rich, and that of Mr. E. Hart (without whose assistance no history of Hampshire birds could be complete) at once suggests itself as of preeminent importance. The strictly local collection at Heron Court contains many historical specimens, while the eggs owned by Dr. Rake are of exceptional interest, many of them being referred to in Wise's "History of the New Forest." The work has been excellently planned and carried out. With such a wealth of historical facts available the authors proposed not only to deal with the birds as they exist at this moment, but to trace their history in the writings of those who have gone before them. The "Natural History of Selborne" forms the backbone of the work, and we have here for the first time what White has to say (not only in his book, but also in his still unpublished "Journal of Observations") about the birds of Selborne arranged in scientific order.

Of the more interesting species the authors have given very extended notices, and of all these the honey buzzard is the most important, on account of its having been found in former years more commonly in this county than in any other part of England. Among other birds of which valuable accounts are given may be mentioned the raven, buzzard, hobby, Montagu's harrier, cirl bunting, hoopoe, and great bustard. The breed of peregrines for which the Isle of Wight was famous in the old days of hawking still keeps a footing there; and to turn from decreasing species, it is pleasant to read that the redshank is increasing as a resident; that White's "clamouring" favourite, the stone curlew, is happily still plentiful, and that the woodcock, shoveller, and tufted duck are becoming more numerous as breeding species. But whether the great increase in numbers of the black-headed gull will prove an unmixed blessing is perhaps open to doubt.

FIG. 1.—Black-headed Gull. From "The Birds of Hampshire and the Isle of Wight." From a photograph by Mr. Smith Whiting.

A curious account is given of some merlins breeding in Hampshire in the early 'sixties. The nests, which were stated to have been found in such previously unheard-of situations as pollard hollies, and holes in yew and beech trees, contained three eggs in each instance. We should certainly have been inclined to refer these eggs to the kestrel had not the male bird been shot from the nest in one instance, and had not its skin, together with the eggs, been

[1] "The Birds of Hampshire and the Isle of Wight." By the Rev. J. E. Kelsall, M.A., and Philip W. Munn. Pp. xliv+371; illustrated. (London: Witherby and Co., 1905.) Price 15s. net.

still in existence. An interesting introduction closes with an account of the laws applying to local birds; and the volume is embellished with a map of the district, four drawings by Mr. G. E. Lodge, and reproductions of some most beautiful photographs of birds by Mr. Smith Whiting, one of which we are enabled to reproduce. O. V. APLIN.

THE ADULTERATION OF BUTTER.

DURING the last few years much unscrupulous ingenuity has been applied to the sophistication of butter. Both on the Continent and in this country the adulteration of this, the best of edible fats, has developed into quite an industry, having its own factories and its own chemists, and conducting its operations on a scale which, for a furtive, dishonest business, is really of remarkable magnitude. Considerable profits are alleged to be made, and it is therefore not surprising that the traffic has flourished in spite of all attempts at suppression. Perhaps it may be of interest to those readers of NATURE who are not chemists to have placed before them, with as little technicality as may be, a sketch of the modern methods of butter-adulteration, and of the means adopted or suggested to checkmate this form of fraud. The importance of the matter both to the consumer and the agriculturist may be pleaded as a justification for discussing the question at some little length.

Butter, though consisting essentially of the fat of milk, is always associated during manufacture with more or less water, the quantity of which ranges generally from 7 to 15 per cent. One of the simplest forms of adulteration consists in working an excessive proportion of water into the butter. To check this is comparatively easy; a maximum limit of 16 per cent. has been fixed by the Board of Agriculture, and persons dealing in butter containing more water than this are liable to prosecution.

There exists, however, an insidious variant of this water-logging in the production of what is called "milk-blended" butter. In preparing this, skim milk, costing about a penny per gallon, is largely used. It may either furnish curd to be incorporated with the butter, or, after a little "ripening" with micro-organisms to improve the flavour, it may be used for direct admixture. By working up butter with such milk a product may be obtained containing 25 to 30 per cent. of water, as well as a substantial quantity of curd. The proportion of butter-fat in such a mixture will often be less than 65 per cent., whereas ordinary butter contains from 80 to 90 per cent. Yet the sale of the article is not, legally, a fraudulent transaction, provided the substance is sold as "milk-blended" butter, and not simply as "butter." At first sight this may seem reasonable enough; the purchaser is told what he is buying, and for the rest—well, *caveat emptor*. But, after all, some regard should be had to attendant circumstances. It is the poor who chiefly consume the manipulated butter, and neither they, nor, indeed, any ordinary purchaser, would realise that the fat-value of the blended article is only about three-fourths of that of genuine butter. Of course, if the price is correspondingly lower there is no fraud. But the contention of those who oppose the sale is that there is always a substantial margin of unfair profit; "milk-blending," in fact, is held to be essentially a device for supplying an excessive proportion of water, relative to the amount of fat, without incurring the penalties provided for infringement of the Sale of Butter Regulations.

Be this as it may, a measure to prohibit the use of the word "butter" for such mixtures, on the ground that it is a misleading description, was brought forward two or three sessions ago, only to be sacrificed to the exigencies of politics. It remains to be seen whether a better fate is in store for it under the new Administration.

Perhaps, however, the most frequent, and certainly the most troublesome, sophistication of butter consists in the admixture with it of fat other than that of milk. There are two chief adulterants of this class now in use. One is a soft fat obtained from beef-suet by removal of the harder "stearin" portions; this fat may sometimes be mixed with or replaced by lard, and is generally churned up with water (or with milk) to facilitate the subsequent "blending." The other adulterant is a refined cocoa-nut "oil" or fat, purified so as to be practically tasteless. These substances, supplied at about half the price of butter, are variously known as "mixing article," "enricher cream," "neutral fat," or "neutral blending," and are carefully prepared to simulate butter in consistency. A still more subtle adulterant is formed by a judicious mixture of the two, which yields analytical figures identical in some respects with those of genuine butter. Let us examine this a little more closely.

Chemically, butter-fat consists of a mixture of glycerides—that is to say, compounds of fatty acids with glycerin. For instance, one such glyceride may, with sufficient accuracy for our present purpose, be represented as the following combination:—

$$\text{Glycerin}\begin{cases}\text{Oleic acid}\\ \text{Palmitic acid}\\ \text{Butyric acid}\end{cases}\textit{minus}\ \text{water.}$$

When these acids are freed from their chemical union with the glycerin, the butyric acid is found to be sharply distinguished from the other two by the fact that it is soluble in water and volatile on distillation with steam. Now the chief difference between butter-fat and other fats lies in the comparatively high proportion of butyric acid (and similar volatile acids) which the butter-fat contains. The following summary represents the composition of a specimen of the prepared beef-fat and of two samples of butter-fat:—

	Prepared beef-fat	Butter-fat No. 1	Butter-fat No. 2
	Per cent.	Per cent.	Per cent.
Volatile or soluble acids	Practically nil	5·0	6·7
Insoluble acids	95·5	90·0	88·0
Glycerin	10·9	12·1	12·7
	106·4	107·1	107·4
Less combined water	6·4	7·1	7·4
	100·0	100·0	100·0

Like other natural products, the fat of milk varies in the proportions of its components, and the two samples here quoted show the range of variation met with in ordinary butter. Analytically, No. 1 is butter of low quality; No. 2, on the other hand, is above the average. The difference consists, as will be seen, in No. 1 containing less volatile acids, less glycerin, and more insoluble acids than No. 2. These are precisely the directions in which beef-fat differs from butter-fat. Broadly, one may say that, analytically, the first specimen of butter has more of a beef-fat character than the second.

This is the point which the adulterator seizes upon. "If," he argues, "I start with butter No. 2, I can add to it quite a considerable quantity of my prepared beef-fat before the mixture shows a smaller percentage of volatile acids than butter No. 1 contains; and since No. 1 is perfectly genuine butter, it is difficult to see how any analyst will be able to swear that my mixture is not also genuine butter." Indeed, the analyst often finds it no easy matter to expose the

fraud. If butter had always the same composition the matter would be simple enough. It is the natural variation, small though it be, which has hitherto enabled the sophisticator to pocket his ill-gotten fortune.

This variation arises from a number of causes, of which some at least have been fairly well elucidated. In the main it is due to differences in the feeding and treatment of the cows. For instance, Dr. J. J. L. van Rijn showed some years ago in Holland that with the approach of winter, when grass was becoming poorer and less plentiful, and cows, kept late in pasture, were much exposed to cold, the proportion of volatile acids in the butter became abnormally low; but that as soon as the animals were stabled, and therefore better fed and protected from inclement weather, the volatile acids began to increase. To treat the cows more generously in the matters of warmth and provender was thus the remedy for the abnormality indicated. Nevertheless, there still remain some minor causes of variation, such, for instance, as the different physiological conditions of the cows in varying stages of lactation. The effects of these, however, are largely neutralised when we deal with butter made from the mixed milk of many cows; though they have to be taken into account where nothing is known about the history of a particular specimen of butter.

What, then, it may be asked, are the means by which any check at all can be placed upon the sophistication? Having regard to the variation in admittedly genuine samples, is not analysis useless except in very gross cases of fraud? By no means. Let us see what it can do, and how it may be supplemented.

In his search for adulterants the analyst may determine the following constants of the butter-fat he is examining:—(1) Its specific gravity: in butter this is higher than in beef-fat, but lower than in cocoa-nut oil; (2) its refractive index: this again is intermediate in value between those of the two adulterants mentioned; (3) its "saponification" value, which gives a measure of the total quantity of fatty acids and also of the glycerin; and (4) most important of all, the proportion of volatile acids. So far as concerns butter, these physical and chemical data are all correlated with the fact that glycerides of the volatile acids form a relatively large proportion of the genuine fat. They are therefore correlated with one another, and, within limits, are interdependent. The more volatile acid there is, the greater is the specific gravity and the higher the saponification value, whilst the refraction alters inversely. There is thus a kind of parallelism preserved among the constants of genuine butter, notwithstanding the variations in their absolute values. For instance, given genuine butter-fat such as that already referred to as "No. 2," with 6.7 per cent. of volatile acids, one can predict with confidence that its specific gravity will be pretty close to 0.9130 (37°.8 C.), and its saponification value not much different from 232. On the other hand, if the butter-fat contains, like No. 1, only 5 per cent. of volatile acids, we can say with equal confidence that its specific gravity will be about 0.9105, and its saponification value approximately 222.

Suppose, now, an adulterator mixes cocoa-nut oil with the first of these butters until he has reduced the volatile acids from 6.7 per cent. to 5 per cent., the quantity in the second butter. Such an admixture would easily be detected, notwithstanding the fact that the volatile acids correspond in quantity with those of genuine butter. For one thing, these acids can be further examined and made to yield evidence of the admixture; and for another, the addition of the cocoa-nut oil has destroyed the parallelism referred to; the figures are now quite inconsistent with one another, and the sophistication is readily demonstrable. Speaking generally, with a sufficiently extended analysis there is no particular difficulty in detecting relatively small quantities of cocoa-nut oil in butter. But a mere determination of the proportion of volatile acids will not suffice—which explains, perhaps, why this special form of fraud has enjoyed a rather longer life than it might otherwise have had.

The addition of beef-fat or lard is somewhat more difficult to prove. Reliance has chiefly, though not entirely, been placed upon the consequent diminution of the volatile acids. Unfortunately, the natural variation of these in genuine butter is rather considerable, as has been pointed out. Yet even so, it does not follow that the lowest known limit for volatile acids must be taken as the criterion in forming a judgment. There are often collateral circumstances which narrow the range of admissible variation. For instance, a large consignment of "creamery" butter must necessarily, under ordinary commercial conditions, be a product of the mixed milk of many cows, and hence the proportion of volatile acids must tend towards the average value. The minimum quantity, which in exceptional circumstances milk-fat from a single cow might admittedly show, is here lost in the general mean. No weight need be given to it in judging the genuineness of the butter. Similarly, samples purporting to be butter produced in the summer or winter months cannot claim to be judged by the low minimum sometimes found in autumn butter. Again, it may be known, from systematic analyses of genuine butter produced in a certain region, and sampled in circumstances which guarantee the representative character of the samples, that the butter of this region in a specified month did not, as a fact, fall below a particular value in the matter of volatile acids. By having regard to these and similar considerations, as well as to the actual analytical figures, it has been possible in many cases where butter adulterated with beef-fat or lard had been imported into this country from the Continent, not only to prove the fact of the adulteration, but to form a fairly close estimate of its amount.

Some check has thus been placed upon the fraud in question. Yet, although the means at disposal will serve to discover the more considerable amounts of adulteration, there is still a residuum of cases which are either doubtful or in which the legal proof is difficult by reason of the clever way in which advantage has been taken of the natural variation in the constants of butter. To deal with these cases other means are required in supplement of the chemist's work. In Denmark, for instance, there is official supervision of the butter industry; and in Holland the Government has organised an admirable system of State "control," whereby the official *imprimatur* is accorded to butter produced in factories under the Government inspection. Joining the "control," however, is at present a voluntary matter, and for factories not under it, and which may be suspected of malpractices, a compulsory and more rigid system of inspection has been proposed. In this country a considerable amount of falsification has been going on. Enterprising and unscrupulous individuals import or manufacture the adulterants mentioned above, and offer, in consideration of a substantial fee, to initiate the proprietors of butter-blending factories into the whole art and mystery of butter-"faking." As regards the suppression of this, the Customs authorities in the first instance endeavour to secure that all importations of adulterants coming within the legal definition of margarine shall be marked accordingly,

in order that their destination may be the better traced. Further, the traffic in the finished mixture has been somewhat checked by a number of prosecutions, undertaken by Government in the case of imported products, and by a few local authorities in cases where the "blended" butter was sold in this country. But to kill the snake instead of merely scotching it additional weapons are required. Useful measures for this purpose would be: (1) To adopt a recommendation made by a departmental committee some years ago, that a minimal limit for volatile acids should be fixed, below which a presumption should be raised that the butter is not genuine; this would strengthen the hands of the public analyst, and though it would not altogether stop the adulteration, it would restrict its amount and diminish the profits accruing therefrom. (2) To enact that no substance shall be sold as butter if it contains less than 80 per cent. of butter fat; this would prevent the "loading" of butter with curd or "solidified milk." (3) To organise a system of strict inspection of butter factories. (4) To give the Commissioners of Customs greater powers for regulating the admission into this country of adulterated butter and of substances which may be used in the adulteration of butter. (5) Most effective of all would be for the Government of each butter-exporting country to adopt some system modelled on the Netherlands "control" plan of combined inspection and analysis, and to furnish an official voucher of purity, without which the butter would either not be admitted here at all, or only under special conditions of marking. For this, however, we shall have to wait.

C. Simmonds.

A REMARKABLE DISCOVERY IN EGYPT.

On February 7 a most important discovery was made by Prof. Naville at Thebes. The excavation of the eleventh dynasty temple at Deir el-Bahari, discovered by Prof. Naville and Mr. H. R. Hall, of the British Museum, in 1903, has since been carried on for the Egypt Exploration Fund by these gentlemen, assisted by Mr. E. R. Ayrton. Mr. Ayrton being unable to continue working for the Fund this year, his place was taken by another of the Fund's excavators, Mr. C. T. Currelly, who joined the expedition for the first time this year. During this season work was first carried on by Messrs. Hall and Currelly in the southern court of the temple. Here were discovered some interesting priests' houses (?) of brick, dating from the time of the twelfth to eighteenth dynasties, and the south temenos-wall of the temple. This wall was found to be of the same type as the south wall of the great temple of Queen Hatshepsu, which was thus shown to be in reality the north temenos-wall of the eleventh dynasty temple. Later on Mr. Hall began the excavation of the back part of the temple to see how it ended. He discovered, Prof. Naville says, "the enclosure wall and found that the enclosure was interrupted by a court or wide avenue, lined on both sides by a single row of columns, and directed towards the mountain. The rock had been cut open to make way for the avenue."

Later on, when Prof. Naville reached Thebes and Mr. Hall left for England, work was directed to the exploration of the remains of an eighteenth dynasty building, also in the back part of the temple, which had been discovered by Messrs. Hall and Ayrton in 1904. At the end of this building was made Prof. Naville's splendid discovery, described by him in the *Times* recently. It consists of a cell or chapel excavated in the rock, lined with coloured relief sculptures depicting King Thothmes III. making offerings to the god Amen, and in the midst of it was found intact the original cult-image, a great painted and gilded stone cow, of life size. The cow was the emblem of Hathor, goddess of the western deserthills, who was specially venerated at Deir el-Bahari. The image was dedicated by King Amenhetep II., the son and successor of Thothmes III. The chapel belongs really, not to the eleventh dynasty temple, although placed at the end of it, but to the great temple of Deir el-Bahari, with which it is contemporary. The great interest of the figure of the cow, besides its importance as a work of art, lies in the fact that this is the first time that an Egyptian cult-image has been found intact in its shrine. The whole chapel and image will be re-erected in the Museum of Cairo. Illustrations of the find were published in the *Graphic* and *Daily Graphic* of March 2.

This discovery is the latest proof of the remarkable nature of Prof. Naville's work for the Egypt Exploration Fund at Deir el-Bahari, which is one of the most interesting sites for archæological work in Egypt, and one of the most productive of interesting small antiquities, chiefly votive offerings to Hathor of the time of the eighteenth dynasty. These often are in the shape of little cows of blue glazed faïence, models of the great cult-images in the various cave-shrines of Hathor, of which the newly discovered chapel is one, the chief being the well known Hathor-shrine, with the red painted reliefs, on the platform of the great temple, found by Mariette many years ago.

The work of the Egypt Exploration Fund, which is now being carried on by Prof. Naville and his assistants alone, needs considerably more monetary support than is at present being extended to it. It is to be hoped that this discovery will act as an incentive to those who are really scientifically interested in the progress of archæological knowledge, no matter by what *person* that progress is effected, to give their help to the Egypt Exploration Fund, which discovered Naukratis and the store-city of Pithom, identified the route of the Exodus, excavated Tanis, Bubastis, and Herakleopolis, scientifically explored the tombs of the most ancient kings at Abydos, and is now bringing successfully to an end its most imposing work, the excavation of the two temples of Deir el-Bahari at Thebes.

NOTES.

The Bakerian lecture of the Royal Society will be delivered by Prof. John Milne, F.R.S., on Thursday next, March 22, on "Recent Advances in Seismology."

Prof. O. Hertwig, professor of comparative anatomy, University of Berlin, and Prof. H. O. Osborn, professor of zoology, Columbia University, New York, have been elected foreign members of the Linnean Society.

The annual general meeting of the Chemical Society will be held on Friday, March 30, when the president will deliver his address, entitled "The Living Organism as a Chemical Agency: a Review of some of the Problems of Photosynthesis by Growing Plants."

An unprecedented mining disaster occurred on March 10 at the Courrières colliery in the department of the Pas de Calais. An explosion of fire-damp resulted in the loss of more than 1100 lives. The causes of the explosion have not yet been fully established. The colliery employed 6998 persons, and possesses forty-four seams of coal; the annual output is about 2,000,000 tons. In 1890 attention was directed to this colliery by Sir C. Le Neve Foster on account of the remarkably low death-rate from falls of ground, and it was reported upon by a deputation of H.M. Inspectors of Mines. The average death-rate from

falls of ground per million tons of coal raised in the period 1890 to 1899 in Great Britain was 2·16, whilst at Courrières it was 0·39. The colliery was certainly admirably managed, and this fact makes it difficult to account for the terrible explosion, the immediate cause of which appears to have been an underground fire.

WEATHER of a very wintry type has been experienced this week over the British Islands, and in places the cold has been unusually severe for the time of year. On Sunday a large and important storm area arrived from the Atlantic, and in the course of the day its centre traversed Scotland. As the storm was approaching, strong westerly winds and gales, with heavy rains, were experienced generally. The storm developed considerable energy after reaching the North Sea, the barometer falling as low as 28·4 inches, and in the rear of the disturbance the wind greatly increased from the northward. Strong northerly gales accompanied by heavy squalls of snow or hail were experienced on Monday over nearly the entire country, and the storm occurring at the time of spring tides caused severe floods, especially along our east coast. The German and Dutch coasts have also suffered greatly. Sharp frost was experienced in Scotland and over the northern parts of England.

CANON TRISTRAM, F.R.S., whose death, at the age of eighty-three, took place on March 8, is believed to have been the first zoologist to make special application of the theory of natural selection. This he did in an article on the "Ornithology of Northern Africa," published in the then newly established journal the *Ibis* for October, 1859 (vol. i., pp. 429–433), and before the appearance of the "Origin of Species," grounding his belief solely on the papers communicated to the Linnean Society on July 1, 1858, by Messrs. Darwin and Wallace (Journ. Proc. Linn. Soc., iii., Zoology, pp. 45–62). "Writing," he said, "with a series of about 100 Larks of various species before me, I cannot help feeling convinced of the truth of the views set forth" in those communications. "It is hardly possible, I should think, to illustrate this theory better than by the Larks and Chats of North Africa." There is no room here to reproduce the next three pages, but they are worth reading now if only as recording an early and full acceptance of the Darwinian doctrine, and whether so much courage was shown by anyone elsewhere seems very doubtful.

MR. HALDANE, Secretary of State for War, in making the customary annual statement as to the policy of the Army in the current year, delivered a speech which has been received with much satisfaction in the scientific world. The need for clear thinking and for the application of the methods of science to the affairs of State was recognised frankly and emphasised repeatedly. Mr. Haldane's encouraging words to the military experts of to-day, his definition of the science of military organisation, and his description of a new school of young officers—as much men of science as engineers or chemists—should serve to inspire Army men with the spirit that must actuate successful practice. The Secretary for War assured the nation that our officers are becoming men with scientific training and reflective minds, and there is every hope they will soon work in connection with a thinking department such as that which took so prominent a part in securing the recent Japanese success. It is fortunate for this country that the Secretary for War believes in the application of scientific knowledge to military affairs, and we look forward to the time when this need for scientific thought will be recognised in every branch of the public service.

THE correspondence on the cause of the loss of the coal-tar colour industry, which is represented in Germany by a capital of 5,000,000*l*., with an annual value of about 50,000*l*., and the prospect of other industries passing out of our hands in the same way, continues in the columns of the *Times*. The writer whose article upon the jubilee of Dr. Perkin's discovery gave rise to the correspondence states in the issue of March 10 that in the early days of the coal-tar industry there were not a few accomplished chemists in England, but they could not find employment in the colour factories; and this being the case, the schools naturally felt discouraged in their efforts to produce men specially qualified for such work. "Our methods of policy," he remarks, "must be very different from those adopted in the past if we are to succeed; complete sympathy must be established between science and industry." The meaning and value of research have yet to be understood by the commercial community and the manufacturers of this country; and it is still necessary to impress upon the nation that scientific method is an essential factor of the development of industries. When there is a scientific laboratory in every works, the National Physical Laboratory will be able to take its proper place in a national scheme for the promotion of progress of applied science.

THE death of Mr. J. G. Goodchild removes a geologist and naturalist whose knowledge covered an unusually wide range, including ornithology, glacial geology, physical geology, and mineralogy, in all of which he did useful work, thanks to his thoroughness in testing generally accepted explanations, his independent originality, his keen insight, and his artistic skill. Mr. Goodchild served for more than thirty years on the staff of the Geological Survey, being especially engaged in Westmorland and Cumberland, of which counties he made a comprehensive study. While in London, in the winters, he was for some years a valued worker at Toynbee Hall, living beside it in a Whitechapel tenement, and devoting most of his evenings to the organisation of its science classes. For the past fifteen years he was in charge of the geological and mineralogical collections belonging to the Geological Survey in the Edinburgh Museum, and, in connection with his work there, he edited Heddle's "Mineralogy of Scotland," and prepared a careful monograph on the Scotch zeolites. He was also lecturer in mineralogy and geology at the Heriot Watt College. His most important scientific contribution was his paper on the glacial deposits of the Eden Valley, published by the Geological Society in 1875; it will doubtless rank as one of the classics of British glacial geology, though its influence suffered by its publication fifteen years before the original views there expressed could be correctly appreciated.

THE annual meeting of the Royal Society for the Protection of Birds will be held on March 20. The chair will be taken by the Marquess of Granby, G.C.B.

A REUTER message from Lahore, dated March 10, reports that a severe earthquake has occurred in Bashahr, one of the hill States.

THE Berlin correspondent of the *Times* states that Prof. Koch delivered an address on March 7 at the Kaiser Wilhelms Akademie, in the presence of the German Emperor, on the subject of his investigations into the causes and nature of the sleeping sickness in Uganda and East Africa. His studies, he stated, have entirely confirmed the results of the investigations of Dr. Castellani and Col. Bruce, and he has devoted his efforts in particular to investigating the habits of *Glossina palpalis*, the fly by which the infection is conveyed.

It has been decided to found an International Association of Colonial Agronomy to promote the scientific study of the problems of colonial and tropical agriculture and of the commercial utilisation of natural products. The headquarters of the organisation will be in Paris. The project took shape at the last meeting of the French Association of Colonial Agriculture and Colonisation, when a provisional committee was appointed to organise the International Association, with M. de Lanessan as president and the following vice-presidents:—Great Britain is represented by Prof. Wyndham Dunstan, F.R.S.; Germany, by Prof. Warburg; Brazil, by M. de Piza, Brazilian Minister in Paris; Italy, by Count Sabini; Mexico, by M. de Mier; Holland, by Prof. Greshoff; Portugal, by Prof. Batalha Reis; while France is represented by M. Myre de Vilers, president of the French Geographical Society, Profs. Giard, Müntz, Prillieux and Roux, and MM. Henrique, Tisserand, M. Dybowski, of the French Colonial Office, and Prof. Heim. The first meeting of this committee of initiation will be held this month in Paris.

On Tuesday next, March 20, Dr. J. E. Marr, F.R.S., will deliver the first of three lectures at the Royal Institution on "The Influence of Geology on Scenery." These are the Tyndall lectures; and on Thursday, March 29, Prof. Bertram Hopkinson will begin a course of three lectures on "Internal Combustion Engines," with experimental illustrations. The Friday evening discourse on March 23 will be delivered by Lord Roberts, on "Imperial Defence"; on March 30 by Prof. Zeeman, on "Recent Progress in Magneto Optics"; and on April 6 by Mr. W. B. Hardy, on "The Physical Basis of Life."

From the Egyptian Survey Department we have received a copy of a "Catalogue of the Geological Museum, Cairo," compiled by Dr. W. F. Hume.

In part vi. of vol. xix. of the Proceedings of the Geologists' Association Mr. M. A. C. Hinton describes the horn-core of a ruminant from the Norwich Crag of Bramerton as representing a new species of gazelle, under the name of *Gazella daviesi.*

The eyes of deep-sea animals form the subject of an instructive article, by Dr. O. Rabes, of Magdeburg, in the February number of *Himmel und Erde.* Special attention is directed to the strange larval fish recently obtained during the *Valdivia* expedition in the Antarctic, and also in deep water in the Indian Ocean, and described under the name of *Stylophthalmus paradoxus.* In this creature, the systematic position of which is uncertain, the eyes are mounted, crab-fashion, on stalks, the length of which apparently varies according to age.

The modern practice of supplying hives of bees with new queens at comparatively short intervals renders it essential that a sufficient stock of queen-bees should always be available at a moderate cost to the hive-owner. In America it appears that there are establishments specially devoted to the rearing of queens for sale; but as the price charged is considerable, the entomological section of the Department of Agriculture has issued a Bulletin (No. 55) in which the author, Dr. E. F. Phillips, gives full instructions to enable the hive-owner to breed his own queens.

The mode in which the American prongbuck, or "antelope," protects its young forms the subject of a beautifully illustrated article, by Mr. H. H. Cross, in the March number of the *Century Illustrated Magazine.* According to the author, the female prongbuck, when about to give birth to offspring, proceeds to the middle of one of the numerous patches of cactus occurring in the haunts of these animals, and there, by means of a series of bounds in the descent from which the cactuses are cut to pieces by her sharp hoofs, clears a space in the centre. Here the young are born, and remain for some time, secure from wolves, which are unable to penetrate the cactus-fence. Danger is, however, experienced from eagles, and to protect their young from these birds the antelope are stated to display great courage.

The February issue of the *Quarterly Journal of Microscopical Science*, which completes the forty-ninth volume, contains five articles, all devoted to invertebrates, and all of a highly technical nature. The most generally interesting, perhaps, is one by Mr. D. H. Tennent on a cercarian parasite, *Bucephalus haimeanus,* infesting oysters in America, more especially those growing in brackish water. Mr. W. Woodland continues his investigations into the mode of formation of spicules, dealing in this instance with those of the Cucumariæ, and the "plate-and-anchor" type characteristic of Synapta. The maturation of unfertilised eggs of sawflies is discussed by Mr. L. Doncaster, while Prof. J. E. Duerden endeavours to explain the *rôle* of mucus in his favourite corals, and Mr. W. S. Perrin records observations on the structure and life-history of *Pleistophora periplanetae,* a sporozoan parasite of the cockroach.

Miss Harriet Richardson has prepared a "Monograph on the Isopods of North America," recently published as Bulletin No. 54 of the United States National Museum (pp. liii+727). This work contains careful analytical keys of the families, genera, and species, and a short descriptive account of each species illustrated by text figures of their essential systematic features. The author has evidently spared neither pains nor labour to make her monograph complete, with the result that it must be regarded as an essential part of the outfit of every zoologist who takes an interest in the systematic study of this group of animals.

Tuberculosis in cattle, by Mr. John M. Scott, is the subject dealt with in Bulletin No. 55 of the New Mexico College of Agriculture. Tuberculosis is defined, the extent of the disease, symptoms, and modes of infection are described, and the use of tuberculin is detailed. The Bulletin is illustrated with five capital plates.

A short part continuing the work of the late Mr. G. S. Jenman on the descriptions of West Indian and Guiana ferns has been published. This and future parts will be based on Mr. Jenman's manuscript, and it is anticipated that the work can be carried to completion. In this part the genus Lomaria, containing eight indigenous species, is described.

A department of forestry has been instituted in connection with the South African College, Cape Town. Provision is being made for ten resident students at Tokai, where the arboretum, a forest museum, and other advantages will furnish excellent facilities for the practical work. The curriculum will consist of a preliminary scientific course in the first year, followed by a two years' forestry course.

A bulletin, No. 52, on the agathi plant, issued by the Department of Agriculture, Madras, deals with the cultivation of this plant, *Sesbania grandiflora*, as a support for the betel-vine, the leaves of which form one of the ingredients of the masticatory *pán-sopári.* The agathi plants are topped to prevent them growing too high; the branches

are fed to cattle or used as a green manure for the betel-vines, and the tender leaves and young pods are served as a curry.

In the January number of the Bulletin of the Department of Agriculture, Jamaica, Mr. W. Harris refers the different varieties of yams cultivated in the island to four species, *Dioscorea sativa*, or negro yam; *Dioscorea alata*, or white yam; *Dioscorea cayennensis*, the yellow or afou yam; and *Dioscorea trifida*, the Indian yam or cush-cush. For the destruction of cotton worm and cassava caterpillar, where Paris green is likely to injure the foliage, or when it may be washed off by rain, Mr. W. Fawcett recommends a wash of lead arsenate.

The committee entrusted by the Hawaiian Sugar Planters' Association with the control of the experiment station at Honolulu notifies in its report for the year ending September 30, 1905, that a division of pathology and physiology has been formed under the directorship of Dr. N. A. Cobb, in addition to the division of agriculture and chemistry and a division of entomology. The work of the last named has been chiefly devoted to the study and breeding of insects that prey upon cane leaf-hoppers. Among the bulletins prepared by the agricultural division, the most important presents a review of fertiliser experiments extending over eight years. A bulletin on the inspection and disinfection of cane cuttings is the first publication of the new department. The methods of preparing Bordeaux mixture are discussed, and suggestions are made for treating cuttings on a large scale.

In the *Engineering and Mining Journal* (vol. lxxxi., No. 7) is the first authoritative statement of the discoveries in a new gold field at Manhattan, in Nevada, which is at present attracting much attention. The veins, which appear to be extraordinarily rich in gold, occur in limestone in the vicinity of rhyolite.

The preliminary returns issued by the Home Office show that the production of coal in Great Britain in 1905 amounted to 236,111,150 tons, or 3,699,366 tons more than in 1904. The number of persons employed at mines under the Coal Mines Regulation Act was 858,373, or 1·28 per cent. more than in 1904. The production of copper ore was 7115 tons, that of lead ore 27,482 tons, and that of zinc ore 23,647 tons. Statistics of the production from open workings are not yet available, so that details of the production of other minerals are incomplete.

In a paper on the screw propeller controversy published in the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part iv.), Mr. James Holden endeavours to demonstrate the true action of the propeller, and to show that Rankine's theory is wholly erroneous. He considers that none of those writers who have adopted the Rankine theory, in whole or in part, are able to guide others, either scientifically or practically, in the construction or use of screw propellers.

The latest addition to technical periodical literature is a bi-monthly journal entitled *Concrete and Constructional Engineering*. It has been founded with the object of meeting the growing demand for information regarding concrete and reinforced concrete. The first issue (March) covers 74 octavo pages, and is admirably illustrated. It contains articles by Lieut.-Colonel J. Winn, on the advent of the concrete age; by Mr. W. N. Twelvetrees, on steel skeleton construction; by Mr. C. F. Marsh, on reinforced concrete foundations of buildings; by Mr. C. H. Desch, on the setting of Portland cement; by Mr. B. H. Thwaite, on the preservation of iron and steel against corrosion; and a digest of recent publications on concrete and constructional engineering.

In the Journal of the Franklin Institute of Philadelphia (vol. clxi., No. 2) Mr. E. Keller describes and illustrates a number of improved methods and apparatus introduced in the newly equipped assay laboratory of the Anaconda Copper Mining Co. in Baltimore. The chief duty of the laboratory is to determine the values of copper, silver, and gold in crude copper, and the equipment is probably superior to any elsewhere. Stirring and filtering are effected by machines, and in assaying operations everything is handled in sets. Much labour has been saved, breakage of expensive glass-ware has been very largely eliminated, and the time of the furnace work and the consumption of gas have been much reduced.

The modern locomotive question is chiefly one of boilers. The great increase in the size of boilers and in the pressures carried, which has taken place during the past few years, has necessitated the re-consideration of the principles of design, which had been settled with comparatively small boilers carrying low pressures. The paper on large locomotive boilers read by Mr. G. J. Churchward before the Institution of Mechanical Engineers on February 16 is therefore opportune. He gives illustrations of various locomotive boilers, and shows how much more heating surface is now provided for a given area of cylinder than was formerly considered necessary. The higher pressures now common have undoubtedly produced much more efficient locomotives, both in respect of hauling power and of coal consumption. The improvement has been very marked with every increment of pressure right up to 227 lb. carried by the new De Glehn compound locomotives of the Great Western Railway.

The report of the superintendent of the Meteorological Department of Ceylon for the year 1904 shows that 1904 must be reckoned as one of the "dry" years; the rainfall was considerably below the average over the greater portion of the island, especially in the north and west, where deficiencies of 10 to 15 inches were recorded in several districts. In May, however, the excess of rainfall caused destructive floods; in the Kelani Valley alone 124 square miles were covered, involving great loss of property, the water being higher than at any time since 1871. The climate varies considerably in different parts of the island; in the lowlands it is tropical, but in the high parts of the interior it is equal to that of many parts of Europe. The highest shade temperature recorded in 1904 was 99°·8 at Anuradhapura, in May, and the lowest, 28°·2, at Nuwara Eliya, in February; this is the lowest reading on record. Temperatures exceeding 100° have been recorded in some years; the highest on record was 103°·7, at Trincomalee, in May, 1890.

In the February number of the *Bulletin de la Société astronomique de France* MM. Flammarion and Loisel publish the annual summary of the climatology of 1905 as recorded at the Juvisy Observatory. It appears that a notable feature of the atmospheric pressure was its extraordinary irregularity. With the exception of February, March, and July, the mean monthly temperatures were below the normal. October was the coldest recorded in the neighbourhood of Paris since 1757, excepting the October of 1887. In discussing the solar-radiation record, attention is directed to the abnormal cloudiness of 1905 and to its coincidence, in regard to time, with the large number of sun-spots. The writers suggest that the

abnormal rainfall was caused by increased evaporation taking place in the tropics, and connect this, and the cyclones, earthquakes, and volcanic eruptions which took place during the year, with the increased solar activity.

MESSRS. LANDER AND SMITH, of Canterbury, have sent us their catalogue of new meteorological instruments. Mr. Lander has given much attention to the problem of providing satisfactory self-recording instruments at popular prices, and has devised new forms of apparatus for registering wind-force and direction, rainfall, sunshine, air pressure, temperature, and humidity. The advantages of using instruments which will give a continuous record are obvious; the desideratum is, of course, that they shall give trustworthy records. The anemometer appears to be a modification of the well known Dines's pressure tube anemometer, with the addition of an arrangement for recording upon a separate paper the direction of the wind as well as its force. The sunshine recorder is of the photographic type, but, unlike other photographic recorders, it makes use of a clock for controlling the admission of the light, so that the record is for mean time instead of for local apparent time as in all other forms. As an example of the efficient working of the different apparatus, Mr. Lander has sent us some reduced curves, here reproduced, of the sharp and sudden thunderstorm of February 8. They clearly show an abrupt drop in the maximum force of the wind from about forty miles an hour to almost a calm, and an equally sudden shift in direction from W.S.W. to N.W. The barometer, which had been falling steadily all day, rose abruptly a tenth of an inch, with a simultaneous drop of 12° in temperature and a fall of rain (or snow) of about a quarter of an inch in a few minutes. During the storm no less than six windmills were struck by lightning near Canterbury, where the records were obtained.

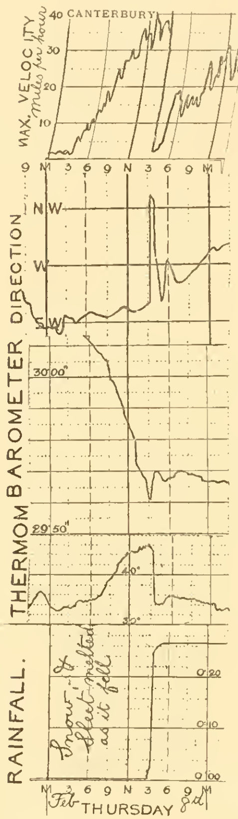


FIG. 1.—Reduced copies of records from self-recording instruments, February 8.

UNDER the title of "An American Laboratory for Experimental Phonetics in Germany," Major H. vom Hagen describes the experiments carried out with the aid of the Carnegie Institution by Prof. E. W. Scripture, first in Munich and later on in Berlin. The paper is illustrated by tracings of phonographic records, and is published in *Prometheus*.

IN the Bulletin of the French Physical Society, No. 235, it is stated that M. Ernest Bichat, who died towards the end of last year, was the author of a number of papers on magnetic rotatory polarisation in gases, and in conjunction with M. Blondlot on oscillating discharges, on Kerr's phenomenon, and on the cylindrical absolute electrometer. He was dean of the faculty of science at Nancy.

A PORTRAIT of Prof. Georg Cantor, of Halle, is published in the January number of the *American Journal of Mathematics*. Cantor's researches on the theory of multitudes and the continuum earned for him the Royal Society's Sylvester medal in 1904, and, speaking of this theory, Dr. Pittard Bullock writes:—"Herr Georg Cantor is looked upon as the discoverer and creator, and in rare cases has a discovery been attributed to one man alone with more readiness." We extract this quotation from a thesis on "The Power of the Continuum." In this thesis Dr. Pittard Bullock gives a proof that the power of the continuum is the lowest but one, or, in other words, that there is no multitude the power of which is lower than that of the continuum but greater than that of a dinumerable multitude.

TWO papers on the vibrations and stresses in shafting have recently appeared. One, forming the fourth of the technical series of the Drapers' Company Research Memoirs, is based on a paper written by Prof. Karl Pearson in 1885, and deals with torsional vibrations treated by Saint Venant's methods; it is illustrated by a large number of lithographed diagrams. The other is a reprint from the Minutes of Proceedings of the Institution of Civil Engineers of a joint paper by Dr. Chree, F.R.S., Captain H. R. Sankey, and Mr. W. E. W. Millington, dealing in the main with the dangers arising from synchronism between the periods of free vibration of the loaded shaft and the periods of fluctuation of the force or torque applied to it. In a large class of practical applications we have to deal with shafts carrying such loads as flywheels, where the kinetic energy of the shaft itself can be neglected, for purposes of rough calculation, in comparison with that of the loads.

IN a paper on the future of statistics, published in the *Statistical Journal* (lxviii., 4), Mr. J. G. Mandello directs attention, among other matters, to the need of organisation in the publication of statistics. The paper deals, in a large measure, with the tendency to chaos resulting from the ever increasing production of printed literature on statistics. It is becoming more and more difficult as time goes on for a busy man to obtain the information which he requires as to the actual state of knowledge in any branch of statistical science, and the mere consulting of voluminous masses of literature more often than not fails to give the inquirer the information which he requires, and, indeed, is not unlikely to end in the re-publication of work already done. Mr. Mandello's remedy is to limit the output of printed matter, and to devote the money thus saved to the establishment of central bureaux where papers of a highly specialised character could be conserved, in typewritten form, for the use of future inquirers, a staff of officials being appointed for the purpose of giving the necessary assistance. A plan of this kind is already working in connection with the Geological Survey of Belgium. Instead of printing maps, which soon become

superseded, they keep large manuscript maps on which the newest details are at once entered, and any specialist can obtain on application a drawn copy of the map of any region, which is naturally quite correct and up to date. A side-issue, which the author does not consider, is whether people would rush into archives with the same eagerness with which they now rush into print, and whether it might be better if they did not.

THE great alteration which occurs in the fluorescence spectrum of sodium vapour when the wave-length of the exciting light is changed is the subject of a brief communication by Prof. R. W. Wood in No. 4 of the *Physikalische Zeitschrift*. Three kinds of monochromatic light, having wave-lengths 5085, 4799, and 4676 respectively, and generated by a cadmium arc lamp of the Heraeus type, were employed in the experiments.

THE lecture delivered by Prof. Emil Fischer before the German Chemical Society on January 6, and having for its subject his recent researches on amino-acids, polypeptides, and the proteids, is published in the current number of the *Berichte* (No. 3). The lecture covers an extraordinarily wide field, and contains a *résumé* of the experimental results obtained during the past five years by Prof. Fischer and his colleagues. A briefer and more general summary of recent work tending towards the synthesis of proteid material is contributed by Prof. Maillard to the *Revue générale des Sciences* for February 15.

IN the Proceedings of the American Academy of Arts and Sciences (vol. xli., No. 19) Messrs. Gilbert N. Lewis and Plumer Wheeler have studied the electrical conductivity of solutions of potassium iodide in liquid iodine. Such solutions are found to conduct electricity as well as the best aqueous solutions, but they present certain interesting anomalies. In dilute solution the molecular conductivity increases linearly with the concentration, rising to a maximum and then falling as the concentration increases; the phenomena show a certain analogy with the deviations from Ostwald's dilution law in aqueous solutions. The temperature coefficient of conductivity is, moreover, negative for dilute solutions, but with increasing concentration it passes through zero and becomes positive.

ALTHOUGH several attempts have been made to prepare selenium iron alums of the type

$$Fe_2(SeO_4)_3,M_2SeO_4,24H_2O,$$

no compound of this group has yet been obtained. In the February number of the *Gazzetta* Dr. Cesare Roncagliolo describes the method by which he has succeeded in preparing the rubidium and cæsium salts,

$$Fe_2(SeO_4)_3,RbSeO_4,24H_2O, \quad Fe_2(SeO_4)_3,CsSeO_4,24H_2O.$$

As anticipated, these salts were found to be isomorphous with the ordinary alums. As the rubidium and cæsium salts melt at about 40° C. and 55° C. respectively, it may be inferred by analogy with the other alums that the corresponding potassium and sodium alums melt below 0° C. If this is the case, an explanation is afforded of the failure hitherto experienced to prepare these salts.

A SIXPENNY edition of Lord Avebury's "Beauties of Nature and the Wonders of the World we Live in" has been published by Messrs. Macmillan and Co., Ltd.

MESSRS. PERCIVAL MARSHALL AND CO. have published, at 3*d*. net, a pamphlet by Mr. A. H. Stanley dealing with "Patents to Inventors." A chapter on patent agents is included.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have published a second edition of Mr. Bertram Blount's "Practical Electro-chemistry," the first issue of which was reviewed at length in NATURE of April 18, 1901 (vol. lxiii., No. 1642). The present edition has been revised and brought up to date. The revision of the section on organic electrochemistry has been done with the assistance of Dr. Mollwo Perkin.

THE twenty-first session of the London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., will be opened on Saturday, April 28, by an excursion from Nutfield to Redhill, for the observation of parallel escarpments. In addition to the Saturday afternoon excursions, vacation visits extending over two or three days will be made with the view of examining a Tertiary locality in the Hampshire basin, the Cretaceous rocks of north-west Norfolk, Devizes, or Folkestone; the oolites of Swindon or Cheltenham; and the primary rocks of Clifton, the Mendip Hills, the Welsh border, or Leicestershire. The secretary of the class is Mr. J. W. Jarvis, St. Mark's College, Chelsea, S.W.

A COPY of the report of the Felsted School Scientific Society for the year 1905 has been received. The organisation of the members of the society into four sections has now been in working order for two years, and has led to sound collective work, and in some cases originated good individual practical study. Special encouragement is given to the individual efforts of members. Like most similar organisations, this society is greatly in need of funds to supply necessary instruments, specimens, and apparatus to carry out the observations and other work planned by the directors. Men of science could encourage the voluntary study of science in secondary schools by presenting duplicate specimens and unused instruments to school scientific societies. The report shows that a sustained effort is being made at Felsted School to create active interest in the study of science.

MESSRS. ISENTHAL AND CO. have just issued new catalogues dealing respectively with mercury vapour lamps for all purposes, and with electric heating and cooking appliances. The mercury vapour lamps are at present made in three standard lengths of 18 inches, 26 inches, and 38 inches, so as to utilise fully the various standard voltages from 100 volts to 250 volts. At present the lamps are available only for direct current, though they are recommended for use on alternating current in connection with the Grisson rectifier and electrolytic condenser. The catalogue of heating and cooking apparatus is excellently illustrated, and is divided into two sections. The first includes appliances for domestic purposes and use in hotels and clubs, while the second is concerned with technical apparatus for use in factories and laboratories.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c*.—Giacobini's comet (1905*c*) has now become much fainter, but does not set until some $3\frac{1}{2}$ hours after sunset. A further instalment of Herr Wedemeyer's ephemeris is given below:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	(δ true) ° '	log r	log Δ	Brightness
Mar. 16	2 45 1	1 49	0·1371	0·2718	0·51
19	2 54 0	2 59			
22	3 2 28	4 5	0·1714	0·3058	0·37
25	3 10 28	5 5			
28	3 18 6	6 1	0·2022	0·3375	0·28
31	3 25 21	6 53			

As will be seen from the ephemeris, the comet is still traversing the constellation Cetus towards Taurus, and

will enter the latter about March 27. On March 21 it will be only about 2m. directly east of α Ceti.

COMET 1906*b*.—The comet discovered by Dr. Kopff will evidently not become an object of popular interest, for it passed perihelion at least two months ago, and is now fading rapidly in brightness.

Below is given a set of elements and part of an ephemeris published by Herr M. Ebell in Circular 86 of the Kiel Centralstelle :—

Elements.

$$T = 1906 \text{ January } 4{\cdot}1289 \text{ Berlin.}$$

$$\left.\begin{aligned} \varpi &= 138^\circ\ 25'{\cdot}1 \\ \Omega &= 328^\circ\ 24'{\cdot}2 \\ i &= 0^\circ\ 53'{\cdot}5 \end{aligned}\right\} 1906{\cdot}0$$

$$\log q = 0{\cdot}03508$$

Ephemeris 12h. M.T. Berlin.

1906	α (h. m. s.)	δ (° ′)	log Δ	Brightness
Mar. 15	11 31 20	+1 57	9·7514	0·54
19	11 30 10	+2 2	9·7842	0·44
23	11 29 17	+2 6	9·8166	0·36
27	11 28 44	+2 9	9·8486	0·29

A set of elements computed from later observed positions by Mr. Champreux gives the date of perihelion as December 25·17 Greenwich.

REMARKABLE VARIATION IN THE SPECTRUM OF ζ BOOTIS.—In No. 4067 of the *Astronomische Nachrichten* Drs. H. Ludendorff and G. Eberhard direct attention to some remarkable variations which took place very suddenly in the spectrum of the double star ζ Boötis.

A spectrogram taken on June 3, 1905, showed a number of bright emission bands undoubtedly similar to those seen in the spectra of new stars, but another spectrum taken on June 5 showed no trace of these.

On looking over previous spectra obtained at the Potsdam Observatory on June 3, 4, and 26, 1902, respectively, only the hydrogen series lines, the calcium line λ 3934, the magnesium line λ 4481, and possible traces of other absorption lines could be detected. No bright bands were present.

The star is a well known double, classed as a "Sirian" star by Sir Norman Lockyer, as belonging to class I.*a*2 by Prof. Vogel, and as a class A star in the Draper Catalogue.

The question of the variability of the relative brightness of the two components has been much discussed, but was affirmed by W. Struve, Sir W. Herschel, and O. Struve.

A BRILLIANT FIREBALL.—In No. 368 of the *Observatory* Mr. Denning has brought together a large number of observations of a magnificent fireball which was seen in Scotland and the northern counties of England on December 30, 1905.

The meteor appeared at about 4h. 26m., swelled out into a disc, which one observer states was about half the size of the moon, and disappeared when about 10°–15° above the horizon. The trail left by the meteor lasted for about twelve or thirteen minutes according to most observers, and during that time was contorted into a variety of peculiar forms.

From the insufficient data yet to hand, Mr. Denning supposes that this object was a very late ϵ Arietid, having its radiant point at about 40°+23°, and on this supposition the height of the meteor works out at sixty-seven miles over Thornhill, in Dumfries, to twenty-seven miles over a point some six miles south of Arran. The earth-point would be about ten miles N.E. of Rathlin.

Thus the length of the path would be seventy-two miles and the velocity about fifteen miles per second.

In the same journal (Nos. 367 and 368) there is published an interesting discussion of the 1905 Bielid meteors by Prof. A. S. Herschel.

OBSERVATIONS OF PHŒBE DURING 1905.—A number of photographic measures of Phœbe, made during the period May 9 to December 14, 1905, are given in Circular 109 of the Harvard College Observatory. The usual exposure given to each photograph was two hours, and only very faint images of the satellite were obtained; thus they were very difficult to measure exactly, and the resulting residuals are somewhat large.

It is seen from the measures that Phœbe attained its maximum distance from Saturn, viz. 36′·4, on September 5. The average differences between the observed distances and declinations and those computed from the ephemeris published in vol. liii. of the Annals (p. 141) were about −0′·2 and −0′·6 respectively.

THE LEEDS ASTRONOMICAL SOCIETY.—The Journal and Transactions of the Leeds Astronomical Society (No. 12) has just been received, and contains a number of interesting papers which were read before the society during 1904.

In addition to these there is a *résumé* of the society's work during the year, as shown by a number of communications to various journals.

Non-members may obtain the journal for 1*s.* 6*d.* from Messrs. Jackson and Son, Leeds.

NEW MAGAZINES OF BIOLOGICAL CHEMISTRY.

JOURNALS dealing with the chemical aspects of physiological and pathological research have long been current in Germany; but up to the present time English-speaking workers have had to rely on periodicals dealing with all branches of physiology and pathology for the publication of their results. This is by no means disadvantageous to the readers of such journals, for overspecialisation has its drawbacks. But with the ever increasing activity in the biochemical field of research, the need has for long been felt of a special journal, and we have to chronicle the advent of one—the *Bio-chemical Journal*—which supplies the need, under the editorship of Prof. Benjamin Moore and Dr. Whitley, of the Liverpool University. In America also a similar want has been met by the issue of the first numbers of what is there called the *Journal of Biological Chemistry*, which is edited by Prof. Christian Herter, of New York, and Prof. J. J. Abel, of Baltimore.

The prefix *bio* and the adjective *biological* indicate a wider outlook than was implied by the older expression physiological chemistry, for there are chemical matters which have bearings, not only on physiology, but on botany, zoology, and pathology; and, indeed, this broad scope is already recognisable in the early issues of both the journals mentioned. It will be sufficient to take the English journal as an example. In the first number, just to hand, there is a paper by Mr. Joseph Barcroft dealing with the oxygen tension in the salivary glands and saliva, and throwing new light on the question of internal respiration in general. The professor of botany at Liverpool, Mr. Harvey Gibson, contributes an article on the physiological properties of West Indian boxwood, so much used now by the shuttle-makers of the north. The cardiac symptoms noticed in many of these workers are shown to be due to an alkaloid in the wood, which is dissolved out by the perspiration on the hands of the workpeople, and slowly absorbed into the system. Drs. Edie and Whitley describe methods for estimating the daily gain or loss of fixed alkali from the body, and the organic acids in the urine; the application of their results in the case of diabetes is pointed out. It was previously known that in acid poisoning the body protects itself by an increased formation of ammonia from urea; it is now shown that there is a similar protective mechanism at work against excess of alkali in the production of an increased amount of organic acids from carbohydrates. The last paper, by Drs. Moore, Edie, and Abram, more directly illustrates the application of chemical studies to the elucidation of disease. They find that the administration of a neutralised acid extract of the duodenal mucous membrane counteracts diabetes in the few cases examined up to the present. The explanation advanced of the benefit is that the extract stimulates the pancreas to form that internal secretion which regulates carbohydrate metabolism, but which is apparently in abeyance in the diabetic state.

Enough has been said to show the interesting and important kind of material at hand, and we wish our two new contemporaries every success in the future.

FORESTRY IN THE UNITED STATES.

THE United States Geological Survey has already issued in the form of reports various papers dealing with the conditions of the localities in the more important forest reserves. Professional Paper No. 29 of the forestry series of the department deals with the forest conditions in the Absaroka division of the Yellowstone Forest Reserve, Montana, and the Livingstone and Big Timber Quadrangles. This report first treats of the location, extent, and topography of the Yellowstone Reserve. The forest itself is almost wholly coniferous, consisting of pines, spruce, silver and Douglas firs. A most interesting account is given concerning the distribution of these species, especially in regard to altitude and aspect. As regards the ages of the trees the greatest diversity prevails. Age classes occur, varying from 15 to 20 years, 75 to 100 years; also stands from 200 to 300 years old are represented, this condition of things having been brought about by fire, the different age-classes corresponding to burns of different periods. The character and volume of merchantable timber are next carefully gone into. These naturally vary according to the species of tree, as well as the altitude and aspect in which it is growing, and the report brings out very interesting facts in this connection.

FIG. 1.—Cultivated Valley in the Woodland Area of the Lincoln Forest Reserve, New Mexico.

Like other forest reserves, the present one is divided into a number of smaller divisions called townships, which are carefully described in detail. Two useful land classification maps are appended.

A report of the forest conditions in the Little Belt Mountains Forest Reserve, Montana, and the Little Belt Mountains Quadrangle, forms Paper No. 30 of the same series. Here again the principal species are conifers; but the chief value of the forest lies in its effect on the conservation and regulation of the rainfall, hence it is more in the nature of a protection forest than one preserved for its timber production.

The forest conditions of the Lincoln Forest Reserve, New Mexico, are described in Paper No. 33. This reserve was created by proclamation of the President in 1902. The description of the included area is again given by townships. The area is more or less mountainous, and, as a natural consequence, the woodland growths are found to be divided into zones determined by altitude. A very interesting graphical representation of the various zones and species occurring in them is included. Short descriptions of the different species of trees are given, among which the yellow pine (*Pinus ponderosa*) is the chief timber tree. The conservation of trees in the reserve is of enormous importance in connection with the irrigation of cultivated lands in its neighbourhood, or vast areas that could be used for agricultural purposes if a regular supply of water were secured. Artificial tanks are at present employed for the storage of intermittent surface flows of water to be used for domestic purposes and irrigation.

Paper No. 39 consists of a report of the forest conditions of the Gila River Forest Reserve, New Mexico. This reserve was established by President McKinley in 1889. The reserve includes several prominent mountain ranges, and on the whole the area is well watered, the streams from the mountains carrying a considerable flow to a long distance beyond the forest regions. The reserve is traversed by fairly good roads and trails which follow the valleys. Agriculture is extensively carried on along San Francisco River, but not to such an extent along Gila River. The settlers formerly found a very ready market for their produce in the mining camps at Cooney and Mogollon, but several of these camps have been deserted within the last year or two, and the market has become considerably restricted. Grazing is an important industry in this region, but will require careful attention and supervision to prevent the inevitable result of over-stocking, as this not only leads to a total destruction of the grass roots, but also gives rise to drought at one period and disastrous flooding at another. The yellow pine is found to grow very well in this region, and will probably form the principal species in re-stocking the land when the older timber is removed.

FIG. 2.—Artificial "Tank" for Water Supply. Lincoln Forest Reserve, New Mexico.

FORTHCOMING BOOKS OF SCIENCE.

MESSRS. BAILLIERE, TINDALL AND COX'S list includes :—"Applied Bacteriology," by Prof. R. T. Hewlett and C. G. Moor, illustrated; "Laboratory Manual of Physiology," by Dr. F. C. Busch; "Trypanosomes and Trypanosomiasis," by Laveran and Mesnil, translated and edited by Dr. D. Nabarro; "Practical Agricultural Chemistry," by F. Robertson; "Röntgen Rays in General Practice," by R. H. Cooper; and a new edition of "Philosophy of Voice," by C. Lunn.

Messrs. A. and C. Black promise :—"A Treatise on Zoology," edited by Prof. E. Ray Lankester, F.R.S., part v., "Mollusca," by Dr. P. Pelseneer, illustrated.

Messrs. Gebrüder Borntraeger (Berlin) give notice of :—"Hygienisches Centralblatt," edited by Dr. P. Sommerfeld; "Zeitschrift für Gletscherkunde," edited by Prof. E. Brückner; "Tabulae botanicae," edited by Drs. E. Baur and Jahn; "Kryptogamenflora der Mark Brandenburg," Band ii., *Laubmoose*; "Forstbotanisches Merkbuch," iv., *Schleswig-Holstein*; "Allgemeine Botanik," by Prof. Warming; and "Geschichte Roms," by Prof. Drumann, Band iii.

The Cambridge University Press list includes :—"Cambridge Tracts in Mathematics and Mathematical Physics," No. 3, "Quadratic Forms and their Classification by Means of Invariant Factors," by Prof. T. J'A. Bromwich; "Trigonometry for Beginners," by J. W. Mercer. The following are in preparation :—"The Definite Integral, its Meaning and Fundamental Properties," by Dr. E. W. Hobson, F.R.S.; "Singular Points and Asymptotes of Plane Curves," by Prof. C. A. Scott; "The Axioms of Geometry," by Dr. A. N. Whitehead, F.R.S.; and "The Eikonal and its Application to Optical Instruments," by E. T. Whittaker, F.R.S.

Messrs. J. and A. Churchill give notice of :—"A Short Practice of Medicine," by Dr. R. A. Fleming; "Preservatives in Food and Food Examination," by Dr. J. C. Thresh; "Essentials of Surface Anatomy," by C. R. Whittaker; "A Manual of Midwifery," by Dr. T. W. Eden; "Clinical Applied Anatomy; or, the Anatomy of Medicine and Surgery," by C. R. Box and W. M. Eccles; "A Manual of Pathology, General and Special," by Prof. R. T. Hewlett; "A Manual of Prescribing," by Prof. C. R. Marshall; "Spinal Curvature," by H. R. H. Bigg; "Pharmaceutical Latin Grammar; or Prescriptions, how to Write and Read Them," by R. R. Bennett; and new editions of "A System of Dental Surgery," by C. S. Tomes and W. S. Nowell; and "Minor Surgery and Bandaging," by B. Pollard.

Messrs. A. Constable and Co., Ltd., will publish :—"Radio-active Transformations," by Prof. E. Rutherford, F.R.S., illustrated; "The Integrative Action of the Nervous System," by Prof. C. S. Sherrington, F.R.S., illustrated; and "Physiology of the Nervous System," by J. P. Morat translated and edited by Dr. H. W. Syers, illustrated.

Messrs. J. M. Dent and Co. direct attention to :—"English Men of Science," edited by Prof. J. R. Green, F.R.S.—"Herbert Spencer," by Prof. J. A. Thomson; "Priestley," by Dr. T. E. Thorpe, C.B., F.R.S.; "George Bentham," by B. D. Jackson; "Huxley," by Prof. J. R. A. Davis; "Sir Wm. Flower," by R. Lydekker, F.R.S. Of Dent's Mathematical and Scientific Series, the following are in preparation :—"Geometrical Conics," by Profs. G. H. Bryan, F.R.S., and R. H. Pinkerton; "Analytical Conics," by Prof. C. A. Scott; "Mechanics," by C. S. Jackson and R. M. Milne; "Trigonometry," by C. Hawkins; "Algebra," by Prof. H. W. Ll. Tanner, F.R.S., and W. J. Greenstreet; "Practical Mathematics," by J. E. Boyt; "Light," by F. E. Rees; "A French Scientific Reader," compiled by W. J. Greenstreet; "A German Scientific Reader," compiled by C. R. Dow; and "Mathematical Tables," by Prof. G. H. Bryan, F.R.S.

Mr. Gustav Fischer (Jena) announces :—"Flora, oder Allgemeine Botanische Zeitung," Jahrgung 1906, edited by Prof. K. Goebel, Heft i., illustrated; "Klinisches Jahrbuch," fünfzehnter Band, zweites Heft, illustrated; "Physiologie des Menschen," by Prof. L. Luciani, German translation, Band ii., illustrated; "Das Rettungs- und Krankenbeförderungswesen im deutschen Reiche," by Prof. G. Meyer, Bildet zugleich den dritten Ergänzungsband zum klinischen Jahrbuch, illustrated; "Résultats scientifiques du Congrès international de Botanique, Wien, 1905," illustrated; "Die Wirbeltiere Europas mit Berücksichtigung der Faunen von Vorderasien und Nordafrika," by Prof. O. Schmiedeknecht; "Vegetationsbilder," edited by Profs. G. Karsten and H. Schenck, dritte Reihe, Heft vi.: Emerich Zederbauer, Vegetationsbilder aus Kleinasien, illustrated; "Verhandlungen der deutschen pathologischen Gesellschaft," edited by G. Schmorl, neunte Tagung, gehalten in Meran vom 25 bis 29 September, 1905, illustrated; "Gesammelte Abhandlungen," Band iv., Sozialpolitische Schriften, by Prof. E. Abbe; and new editions of "Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbeltiere," by Prof. O. Hertwig, illustrated; "Tabellen zur Gesteinskunde für Geologen, Mineralogen, Bergleute, Chemiker, Landwirte und Techniker," by Prof. G. Linck, illustrated; "Einführung in das Studium der Malariakrankheiten," by Dr. R. Ruge, illustrated; "Anatomische, physiologische und physikalische Daten und Tabellen zum Gebrauche für Mediziner," by Prof. H. Vierordt; and "Lehrbuch der allgemeinen Pathologie und der pathologischen Anatomie," by Prof. E. Ziegler, Band ii., Lehrbuch der speziellen pathologischen Anatomie, edited by Drs. E. Gierke and K. Ziegler, illustrated.

Messrs. Gauthier-Villars (Paris) promise :—"Guide du Météorologiste amateur," by Loisel; "Leçons sur le Séries trigonometriques," by Lebesque; "La Mécanique des Phénoménes fondée sur les Analogies," by Petrowitch; and "Les Conserves alimentaires," by Rocques.

Messrs. Charles Griffin and Co., Ltd., announce :—"The Theory of the Steam Turbine, a Treatise on the History, Development, and Principles of Construction of the Steam Turbine," by A. Jude, illustrated; "Present-day Shipbuilding: abridged from 'Steel Ships,' Revised and Specially Arranged to Meet the Requirements of Shipyard Students, Ships' Officers, and Engineers for their Respective Examinations," by T. Walton, illustrated; "Motor-car Mechanism and Management," by W. P. Adams, in three parts, illustrated, part ii., the Electrical Car, and part iii., the Steam Car; "General Foundry Practice: a Practical Handbook for Iron, Steel and Brass Founders, Metallurgists, and Students of Metallurgy," by A. C. McWilliam and P. Longmuir, illustrated; "The Elements of Chemical Engineering," by Dr. J. Grossmann, illustrated; "Locomotive Compounding and Superheating," by J. F. Gairns, illustrated; "Peat: its Use and Manufacture," by P. R. Björling and F. T. Gissing, illustrated; "The Clayworker's Handbook, an Epitome of the Materials and Methods Employed in Brickmaking and Pottery," by the author of "The Chemistry of Clayworking," illustrated; "Paper Technology, an Elementary Manual on the Manufacture, Physical Qualities, Chemical Constituents, and Testing of Paper and Paper-making Fibres, with Selected Tables for the Use of Publishers, Stationers, and Others," by R. W. Sindall, illustrated; "Lessons on Sanitation," by J. W. Harrison, illustrated; "Toxines and Antitoxines," by Dr. C. Oppenheimer, translated from the German by C. A. Mitchell, with notes and additions by the author, since the publication of the German edition; "The Treatment of the Diseases of the Digestive System," by Prof. R. Saundby; and new editions of "Chemistry for Engineers and Manufacturers," by B. Blount and A. G. Bloxam, vol. i., the Chemistry of Engineering, Building, and Metallurgy; "Petroleum and its Products, a Practical Treatise," by Sir B. Redwood, illustrated; and "Aids in Practical Geology: with a Section on Palæontology," by Prof. G. A. J. Cole, illustrated.

Messrs. Hodder and Stoughton give notice of :—"A History of Egypt from the Earliest Times to the Persian Conquest," by Prof. J. E. Breasted, illustrated; "Every Man's Book of Garden Difficulties," by W. F. Rowles, illustrated; "Every Man's Book of Garden Flowers, with Short Directions for their Culture," by J. Halsham, illustrated; and "A Nature Reader for Senior Students, being an Anthology of the Poetry of Nature," edited by the Hon. Sir John Cockburn, K.C.M.G., and E. E. Speight.

Messrs. Hutchinson and Co. announce :—"Liberia, the Negro Republic in West Africa," by Sir Harry Johnston, G.C.M.G., K.C.B., &c., illustrated; Darwin's "Origin of Species," edited by J. W. Mathews; and Waterton's

"Wanderings in South America," with notes, &c., by W. A. Harding.

In Mr. John Lane's list are:—"Bombay Ducks: an Account of Some of the Everyday Birds and Beasts found in a Naturalist's El Dorado," by D. Dewar, illustrated; "The Wild Flowers of Selborne and Other Papers," by the Rev. Canon Vaughan, illustrated. New volumes in the "Practitioners' Library," edited by H. Roberts: "Forms of Paralysis," by Dr. J. S. Collier; "X-Rays in General Practice," by Captain A. E. Walter. New volumes in the Country Handbooks, edited by H. Roberts: "The Stable Handbook," by T. F. Dale, illustrated; "The Country Cottage," by G. L. Morris and E. Wood, illustrated. New volumes in the Handbooks of Practical Gardening: "The Book of Rarer Vegetables," by G. Wythes and H. Roberts; "The Book of the Winter Garden," by D. S. Fish; "The Book of Market Gardening," by R. L. Castle, illustrated; and a new edition of "Rifle and Romance in the Indian Jungle: being the Record of Thirteen Years of Indian Jungle Life," by Captain A. I. R. Glasfurd, illustrated.

Mr. T. Werner Laurie will publish:—"Fishing for Pleasure and Catching It," by E. Marston, with two chapters on Salmon and Trout Fishing in North Wales by R. B. Marston, illustrated; and "Modern Medicine for the Home," by E. Walker.

Among Messrs. Crosby Lockwood and Son's forthcoming books we notice:—New editions of "The Art of Leather Manufacture," by A. Watt; "Colliery Working and Management," by H. F. Bulman and R. A. S. Redmayne, illustrated; "A Handybook for Brewers," by H. E. Wright; and "Sheet Metal Worker's Instructor," by R. H. Warn and J. G. Horner, illustrated.

Messrs. Longmans and Co.'s list includes:—"Mammals of Great Britain and Ireland," by J. G. Millais, vol. iii., completing the Rodentia with the Hares and the Rabbit; it will also contain the Cervidæ (the Deer family), the Bovidæ (the Oxen), and the Cetaceæ (Whales), illustrated; "Health of Our Children in the Colonies, a Book for Mothers," by Dr. L. A. Robinson; "Plants and their Ways in South Africa," by B. Stoneman; "Design of Lathes for High Speed and Heavy Cutting," by J. T. Nicolson and D. Smith; "Practical Manual of Tides and Waves," by W. H. Wheeler, illustrated; "Scientific Principles of Wireless Telegraphy," by Prof. J. A. Fleming, F.R.S.; "Modern Steam Road Wagons," by W. Norris, illustrated; "Synthetica, being Meditations Epistemological and Ontological, comprising the Edinburgh Gifford Lectures of 1905," by Dr. S. S. Laurie, two vols.; "Plant Response," by Prof. J. C. Bose, C.I.E.; "Mathematical Papers of J. Willard Gibbs," two vols.; "Manual of Diseases of the Nose and its Accessory Cavities," by Dr. H. L. Lack; and "Philosophy of Religion," by Prof. G. T. Ladd, two vols.

Messrs. Sampson Low, Marston and Co., Ltd., will issue:—"Cotton Manufacture," by E. A. Posset, part ii., treating of combing, drawing, roller covering and fly frames, with an illustrated description of all the modern processes and machinery used, also all the calculations required.

Messrs. Macmillan and Co., Ltd., announce:—"Mediæval Rhodesia," by D. Randall-MacIver, illustrated; "The Philosophy of Religion," by Prof. H. Höffding, translated by Miss B. E. Meyer; "Electrical Engineering in Theory and Practice," by G. D. Aspinall Parr, illustrated; "Physical Optics," by Prof. R. W. Wood, illustrated; "A Manual of Geometry," by W. D. Eggar; "Lessons in Science, a Preliminary Course of Physics and Chemistry," by Prof. R. A. Gregory and A. T. Simmons; and a new edition of "Appendicitis: its Pathology and Surgery," by C. B. Lockwood.

Messrs. Methuen and Co. promise:—"Electrical Industry, Lighting, Traction, and Power," "Shipbuilding Industry, its History, Science, Practice, and Finance," "Money Market," "Business Side of Agriculture," "Brewing Industry," "Automobile Industry," "Mining and Mining Investments," "Civil Engineering," "Coal Industry," "Iron Trade," and "Cotton Industry and Trade."

Mr. John Murray announces:—"Heredity," by Prof. J. A. Thomson; "Researches in Sinai," by Prof. W. Flinders Petrie, F.R.S., illustrated; "Noteworthy Families (Science), an Index to Kinships in Near Degrees between Persons whose Achievements are Honourable, and have been Publicly Recorded," by Dr. F. Galton, F.R.S., and E. Schuster; "Our Waterways, a History of Inland Navigation considered as a Branch of Water Conservancy," by U. A. Forbes and W. H. R. Ashford; "Life of Isabella Bird (Mrs. Bishop)," by Miss A. M. Stoddart, illustrated; "The Dead Heart of Australia, a Journey around Lake Eyre in the Summer of 1901–1902, with an Account of the Lake Eyre Basin and the Flowing Well of Central Australia," by Prof. J. W. Gregory, F.R.S., illustrated; "Human Blood, an Introduction to the Normal and Pathological Morphology of Human Blood," eight lectures delivered in the Pathological Laboratory of the University of London, by Dr. G. A. Buckmaster, illustrated; "The Transition in Agriculture," by E. A. Pratt; "Recent Development in Biological Science," by W. B. Hardy, F.R.S.; "Artillery and Explosives, Essays and Lectures Written and Delivered at Various Times," by Sir A. Noble, K.C.B., F.R.S., illustrated; and "Chemistry of the Albumens," by Dr. O. B. Schryver.

The list of the Oxford University Press contains:—"Elementary Chemistry, Progressive Lesson in Experiment and Theory," by F. R. L. Wilson and G. W. Hedley, part ii.; Knuth's "Flower Pollination," authorised English translation by J. R. A. Davis, vol. i.; Solereder's "Anatomical Characters of the Dicotyledonous Orders," authorised English translation by L. A. Boodle and F. E. Fritsch, revised by H. D. Scott; "A Catalogue of the Herbarium of Dillenius," by G. C. Druce, with the assistance of Prof. S. H. Vines, F.R.S.; "The Face of the Earth" ("Das Antlitz der Erde"), by Prof. E. Suess, translated by Dr. H. B. C. Sollas under the direction of Prof. W. J. Sollas, F.R.S., vol. ii., illustrated; "The Oxford Geographies," vol. ii., "The Preliminary Geography," by Dr. A. J. Herbertson, illustrated; "The Dawn of Modern Geography," by C. R. Beazley, vol. iii.; "Lectures on the Method of Science," edited by Dr. T. B. Strong; and a new edition of "Human Anatomy for Art Students," by Prof. A. Thomson, illustrated.

Messrs. G. Philip and Son, Ltd., have in the press:—"A Rhythmic Approach to Mathematics," by E. L. Somervell.

Sir Isaac Pitman and Sons, Ltd., announce:—"Mechanical Traction on Highways in the United Kingdom," by Dr. C. A. M. Barlow; and a new edition of "Home Gymnastics for Old and Young," by Dr. T. J. Hartelius, translated and adapted from the Swedish by C. Löfving, illustrated.

Messrs. G. P. Putnam's Sons promise:—"Jordan Valley and Petra," by Prof. W. Libbey and Dr. F. E. Hoskins, two vols., illustrated; and "Tibet and Turkestan," by O. T. Crosby, illustrated.

The Religious Tract Society announces:—"By-paths in Nature," by F. Stevens, illustrated; and "Every Boy's Book of British Natural History," by P. Westell.

The Sanitary Publishing Co., Ltd., announce:—"Smoky Fogs, How to Prevent," by A. J. Martin; "Drainage, Cast Iron House Drainage, with Especial Reference to the Drainage of Town Houses," by G. J. G. Jensen; and new editions of "Drainage, By-laws as to House Drainage and Sanitary Fittings made by the London County Council," annotated by G. J. Jensen, illustrated; and "Drainage, Modern Drainage Inspection and Sanitary Surveys," by G. J. G. Jensen, illustrated.

The Society for Promoting Christian Knowledge will publish:—"The Frozen South"; a volume on the Spectroscope, by Mr. H. F. Newall; and "The Properties of Liquids," by Prof. C. V. Boys, F.R.S.

Messrs. Swan Sonnenschein and Co., Ltd., promise:—"Physiological Psychology," by Prof. W. Wundt, translated by Prof. E. B. Titchener, in three vols., vol. ii., illustrated; "The History of Philosophy," by Dr. J. E. Erdmann, translated abridgment by W. S. Hough; "Thoughts and Things: a Genetic Study of Logical Process," by Prof. M. Baldwin, vol. i., "Theory of Knowledge, Functional Logic," vol. ii., "Theory of Reality, Real Logic"; "Man: or Problems Ancient and Modern relating to Man, with Guesses at Solutions," by Rev. W. T. Nicholson; "The Student's Text-book of

Zoology," by A. Sedgwick, F.R.S., vol. iii., completing the work, illustrated; "Insect Pests of the Farm and Garden," by F. M. Duncan, illustrated; and "School Gardening for Little Children," by L. R. Latter, with an introduction by Prof. Geddes.

The University Tutorial Press, Ltd., announce:—"Geometry, Theoretical and Practical," by W. P. Workman and A. G. Cracknell, part ii., part iii.; "Arithmetic for the Preliminary Certificate Examination," by H. R. Chope; "Model Answers to Arithmetic Questions for the Preliminary Certificate Examination"; "Algebra, Preliminary Certificate Edition, With Section on Graphs," by R. Deakin; "Geometry, Theoretical and Practical, Preliminary Certificate Edition (for Course A)," by W. P. Workman and A. G. Cracknell; "Euclid, Books i.–iii., Preliminary Certificate Edition, with Mensuration and Practical Problems arranged in Accordance with Euclid's Order of Proof," by R. Deakin; "Key to Matriculation Algebra"; "Logarithms and How to Use Them"; "Chemistry, First Stage, Theoretical Organic," by R. A. Lyster; "Chemistry, the Junior," by R. H. Adie; "Experimental Science, the Junior," by W. M. Hooton; "Hygiene, Certificate," by R. A. Lyster; "Technical Electricity," by Prof. H. T. Davidge and R. W. Hutchinson; "Physiology, First Stage," by Dr. G. M. Meachen; "Elementary Science of Common Life (Chemistry), Subject xxvi. of the Board of Education Science Examinations," by W. T. Boone; "Properties of Matter," by C. J. L. Wagstaff; "Elementary Science for the Preliminary Certificate Examination (General Section)," edited by Drs. R. W. Stewart and W. Briggs; "Elementary Science for the Preliminary Certificate Examination (Section A, Chemistry)," by H. W. Bausor; "Elementary Science for the Preliminary Certificate Examination (Section B, Physics)," by J. Satterly; "Intermediate Hydrostatics"; "Principles and Methods of Education," by Dr. S. S. Fletcher and J. Welton; and new editions of "First Stage Inorganic Chemistry (Theoretical)," by Dr. G. H. Bailey; "Synopsis of Matriculation Chemistry"; "New Matriculation Physics: Heat, Light, and Sound," by Dr. R. W. Stewart; "Light, Text-book of," by Dr. R. W. Stewart; and "Graphs, Graphical Representation of Algebraic Functions," by C. H. French and G. Osborn.

Mr. T. Fisher Unwin promises:—"Haeckel: his Life and Work," by W. Bölsche, translated by J. McCabe, illustrated; and "The Birds of Middlesex," by J. E. Harting, illustrated.

The following are Messrs. Whittaker and Co.'s announcements:—"A Pocket Book of Aëronautics," by H. W. L. Moedebeck, translated from the German by Dr. W. M. Varley; "Electricity in Mines," by P. R. Allen; "Steam Turbine Engineering," by T. Stevens and H. M. Hobart; "Electric Lamps and Electric Lighting," by L. Gaster; "Armature Construction, a Handbook for Electrical Designers," by H. M. Hobart; "Single-phase Commutator Motors," by F. Punga; "A Treatise on Coal Mining," by G. L. Kerr and D. Burns; "Polyphase Electric Currents," by A. Still; and "A Text-book of Botany," part i., "The Anatomy of Flowering Plants," by L. M. Yates.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The board of the faculty of natural science has approved the supplication of Mr. Walter Garstang, Lincoln College, for the degree of doctor of science.

Prof. W. J. Sollas and Dr. T. G. Bonney have been appointed examiners in the honour school of geology.

The grant of 250*l*. a year to the pathological laboratory from the University Chest has been renewed for five years, and additional grants of 100*l*. a year to the Pitt-Rivers Museum and to the Hope department of zoology, and 50*l*. a year to the departments of mineralogy and geology have been authorised by Convocation.

The important collection of New Zealand birds formerly belonging to the late Mr. S. William Silver has been presented to the museum by his widow.

A fellowship examination in chemistry has been announced by Merton College to begin on Tuesday, September 25. Candidates must have passed at the examinations required by the University for the degree of B.A. The value of the fellowship is 200*l*. a year for seven years, and the holder may be re-elected if he is duly qualified. Candidates may submit any dissertations or evidence of research work not later than September 20.

At a meeting of the Junior Scientific Club held on March 7, Mr. Henry Balfour read a paper on "The Natural History of the Bagpipe," and Mr. J. A. Brown one on "Electrons."

CAMBRIDGE.—The late Mr. Frederick James Quick having left his residuary estate to the University, the income to be used in promoting the study and research in the sciences of vegetable and animal biology, the council of the Senate has published a scheme for the administration of the fund. This has been approved by the trustees, to whom the will entrusts very considerable powers of emendation and alteration. It is proposed to establish a Quick professorship of biology with a salary of 1000*l*. a year, and with a sum not exceeding 300*l*. a year for the maintenance of a laboratory. In the first instance the professor is to devote himself to the study of the protozoa, especially such as cause disease. He will not be required to give lectures in more than one university term, when he will be expected to set forth the result of the researches carried on in his laboratory. By the terms of the will the professor must seek re-election every third year. The administration of the fund will rest with a board of managers, the members of which will also act as electors to the professorship.

The first report of the Studies and Examinations Syndicate with regard to the abolition of compulsory Greek having been rejected by the Senate, the Syndicate has tried again, and has issued a second report, in which it suggests what is known as a "bifurcation of studies." It is proposed that both in the honours and in the ordinary course for degrees the examinations shall be grouped into two sections, the literary and the scientific, and that while those who pursue the literary side must take in the Previous Examination two classical languages, those on the scientific side will be required "to take two languages other than English, one of the two being Latin or Greek." When the proposals come to be discussed a certain amount of opposition may be expected from the historians and moral science teachers, whose students are afforded no relief. Whether the masters of the situation, the non-resident members of the Senate, will allow the proposals to be accepted is doubtful. It is a well known fact that when the first report of the Syndicate was voted upon, a decided majority of the resident members of the University voted for reform. If the residents are again beaten they must put their trust in the Royal Commission which, from various signs, seems not so very far off.

The late master of Corpus Christi College, Dr. E. H. Perowne, has left his valuable collection of amber from the Norfolk coast to the University, to be deposited in the Sedgwick Geological Museum or in the Fitzwilliam Museum.

It is proposed to grant a sum of 75*l*. out of the works fund to Mr. W. G. Fearnsides, of Sidney Sussex College, towards defraying the expense of a visit which he proposes to make to Sweden to study the Tremadoc and Arenig beds.

The following have been appointed examiners in the special examination in geography and the examination for the diploma in geography:—Mr. G. G. Chisholm, Mr. A. R. Hinks, Mr. H. Y. Oldham, and Prof. W. W. Watts.

The next combined examination for sixty-six entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all these colleges. Scholarships and exhibitions will also be offered for history, for modern languages, and for Hebrew.

WE learn from *Science* that Mrs. A. A. Anderson has given 20,000*l*. to Barnard College, Columbia University, toward the establishment of a course in science.

THE fifth annual students' soirée of the Sir John Cass Technical Institute will be held on Saturday, March 17. The guests will be received by Sir Owen Roberts, chairman of the governing body, and Lady Roberts, Mr. George Baker, J.P., vice-chairman of the governing body, and Mrs. Baker. Short lectures and demonstrations on scientific subjects will be given during the evening.

AT the last meeting of the council of the University of Birmingham several appointments to the staff were made. Mr. George S. West was appointed assistant lecturer and demonstrator in botany in succession to Dr. A. J. Ewart; Dr. Theodore Groom was appointed senior lecturer in geology and geography to succeed Prof. W. W. Watts, F.R.S., recently appointed to the chair of geology in the Royal College of Science, London; and Mr. Donald M. Levy was appointed demonstrator in metallurgy to succeed Mr. H. N. Schnurmann. Communications were received announcing the bequest by the late Mr. John Feeney of the sum of 20,000*l.*, a donation from Messrs. W. and T. Avery, Ltd., of 500*l.*, and valuable gifts from Messrs. Veritys, Ltd., Mr. J. C. Vaudrey, and Mr. Willoughby Ellis. An assistant lectureship and demonstratorship in civil engineering was established.

FOR the last few years Oberlin College has been engaged, says *Science*, in raising a fund of 100,000*l.* This is now almost complete. The fund was started by an anonymous donor of Boston, who promised 20,000*l.* At the time of the trustees' meeting in November last the fund had reached 67,000*l.* Since then numerous gifts have been made, including 1000*l.* for library endowment, 400*l.* for additions to the women's gymnasium, 2000*l.* toward a men's building, 6600*l.* from the estate of Dr. C. N. Lyman, of Wadsworth, O., which will be devoted to library endowment, 15,000*l.* to be used as endowment for the Slavic department of the seminary, 2000*l.* for library endowment, and 1000*l.* for the art building. In the total of 97,000*l.* now raised is counted 25,000*l.* promised by Mr. Carnegie for a library, on condition that 20,000*l.* be raised for library endowment. To complete the fund, therefore, it will be necessary for the college to raise about 10,000*l.* more. It is expected that this will be done before commencement.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, March 1.—Mr. A. G. Vernon Harcourt, F.R.S., past president, in the chair.—Studies of dynamic isomerism, part iv., stereoisomeric halogen derivatives of camphor: T. M. **Lowry.** Measurements were given of the solubility in alcohol of α-chloro- and α-bromocamphors, $\alpha\beta$- and $\alpha\pi$-dibromocamphors, and $\alpha\beta$- and $\alpha\pi$-chlorobromocamphors, both alone and in presence of a small proportion of sodium ethoxide. The increase of solubility on addition of the alkali is ascribed to the formation in the solution of a small proportion of the stereoisomeric α'-compound.—The coagulating action of colloids, part i.: W. P. **Dreaper** and A. **Wilson.** The results obtained by the authors throw some light on dyeing and tanning processes. The influence of gallic acid in the manufacture of leather seems to be of a more direct nature than was previously supposed.—Studies on optically active carbimides, iii., the resolution of α-phenyl-α'-4-hydroxyphenylethane by means of *l*-menthylcarbimide: R. H. **Pickard** and W. O. **Littlebury.** The *l*-menthylcarbamates formed by combination with *l*-menthylcarbimide can be separated by fractional crystallisation, and are then hydrolysed by alcoholic sodium hydroxide.—Experiments on the synthesis of the terpenes, part viii., synthesis of the optically active modifications of Δ^3-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene: F. W. **Kay** and W. H. **Perkin,** jun. Δ'-Tetrahydro-*p*-toluic acid, *l*-Δ^3-*p*-menthenol(8), $\Delta^{3:8(9)}$-*p*-menthadiene, and *d*-$\Delta^{3:8(9)}$-*p*-menthadiene have all been synthesised. By fractional crystallisation of the brucine and strychnine salts of the first-named compound it was resolved into optical isomerides, and from these the two other compounds were prepared in an optically active condition.—Studies in the acridine series, iii., the methylation of chrysaniline: A. E. **Dunstan** and J. T. **Hewitt.** —Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c.: T. E. **Thorpe.**—Nitrogen halides from camphoryl-ψ-carbamide: M. O. **Forster** and H. **Grossmann.** The action of potassium hypobromite and hypochlorite on camphoryl-ψ-carbamide has been found to give rise to dihalogen derivatives which have all the properties of compounds containing halogen attached to nitrogen.—The relation of position isomerism to optical activity, vi., the rotation of the menthyl esters of the isomeric chloronitrobenzoic acids: J. B. **Cohen** and H. P. **Armes.** In the present investigation the combined effect of the halogen and nitro-group on the activity of the menthyl group has been examined.

Mathematical Society, March 8.—Prof. W. Burnside, vice-president, and subsequently Sir W. D. Niven, vice-president, in the chair.—Sommerfeld's diffraction problem and reflection by a parabolic mirror: Prof. H. **Lamb.** Sommerfeld's problem is that of the diffraction of plane waves by a plane screen bounded by a straight edge. It is shown that Sommerfeld's solution may be arrived at in a simple way by combining certain simple particular solutions of the general equation of wave motion when expressed in terms of the coordinates that define two systems of confocal parabolic cylinders, the edge of the screen being the line of foci of the cylinders. Slightly modified forms of these solutions lead to a complete solution of the problem of reflection by a convex mirror in the form of a parabolic cylinder. It appears that in this application of the wave theory the reflected waves, which the ordinary processes of geometrical optics represent as diverging from a line of sources coinciding with the line of foci of the cylinder, really diverge from a plane of sources, terminated in an edge at this line, and extending thence with continually diminishing strength to an infinite distance on the concave side of the mirror. The problems of reflection by concave parabolic and paraboloidal mirrors are also discussed.—Function-sum theorems connected with the series $\sum\limits_1^\infty x^n/n^2$: Prof. L. J. **Rogers.** The sums of the values of the function defined by the integral $\int_0 -(1-x)^{-1}\log x dx$ for various sets of values of the argument are shown to have definite constant values.—Investigations on series of zonal harmonics: Prof. T. J. I'A. **Bromwich.** The paper relates to the behaviour of series of the type $\Sigma a_n r^n P_n(\cos\theta)$ in the neighbourhood of points on the boundary of the region of convergence.—The functions $g\beta(x, \theta)$ and $f\beta(x, \theta)$ Rev. E. W. **Barnes.** The paper deals with the asymptotic expansions of special types of integral functions.—The relations between the *p*-line determinants formable from a *p* by *q* array: Prof. E. J. **Nanson.**—An informal communication On the divisors of numbers of certain forms was made by Lieut.-Colonel A. **Cunningham.** The special forms are $q2^q+1$ and $(a^{4x}+1)^3+1$.—Dr. F. S. **Macaulay** made an informal communication On the equilibrium of forces of given magnitudes the lines of action of which pass through given points.

PARIS.

Academy of Sciences, March 5.—M. H. Poincaré in the chair.—The suboxides of carbon: M. **Berthelot.**—Some arithmetical consequences of the theory of Abelian functions: G. **Humbert.**—The propagation of a movement round a centre in an elastic, homogeneous, and isotropic medium: study of the wave produced without change of density: J. **Boussinesq.**—The bean containing hydrocyanic acid, *Phaseolus lunatus*: L. **Guignard.** Frequent cases of poisoning of animals by this bean have occurred, due to the hydrocyanic acid it contains. This acid arises from a glucoside, phaseolunatine, which is present in the bean. Determinations of the amounts of hydrocyanic acid obtainable from beans from various sources gave figures varying between 0·006 per cent. and 0·102 per cent. A new method for detecting traces of hydrocyanic acid is given.—The synthesis of three dimethyl-cyclo-hexanols: Paul **Sabatier** and A. **Mailhe.** The method of Sabatier and Senderens has been applied to the addition of hydrogen to the three xylenols. Details of the preparation of these substances are given, together with their physical properties and those of their immediate derivatives.—The mag-

netic chart of the British Isles: B. **Baillaud** and E. **Mathias.**—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the fourth quarter of 1905: J. **Guillaume.** Observations were possible on thirty-three days during the quarter. The results are given in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—The deformation of quadrics: Luigi **Bianchi.**—The singularities of solutions to some partial differential equations of the elliptic type: Serge **Bernstein.**—The measurement of the loss of phase by reflection: A. **Perot.**—The phenomena of phosphorescence: A. **Debierne.**—Contribution to the study of selenious anhydride: Œchsner **de Coninck.**—The iodomercurates of calcium and strontium: A. **Duboin.** Crystallised compounds were isolated possessing the composition $CaI_2.HgI_2.8H_2O$ for the calcium salt, and $SrI_2.5HgI_2.8H_2O$ for the corresponding strontium salt.—The nature of the decomposition of an aqueous solution of copper sulphate by some alloys of aluminium: H. **Pecheux.** In a previous note these reactions have been studied from the qualitative side. The present paper is concerned with the quantitative aspect of the same reactions.—The estimation of cadmium: H. **Baubigny.**—The thermochemistry of the hydrazones and the osazones: Ph. **Landrieu.**—The condensation of benzidine-aniline, diphenyl-bidiazoaminobenzene, and diphenyl-disazoaminobenzene: Léo **Vignon.**—An antimony tartrate: J. **Bougault.** It is shown that the use of alcohol in the preparation of antimony tartrate leads to an impure product; similar objections do not apply to acetone.—The chemical study of the seeds known as Java peas: Émile **Kohn-Abrest.** Determinations of the amounts of hydrocyanic acid produced by various modes of treating the seeds.—The chemical characters of the wines arising from vines attacked by mildew: E. **Manceau.**—The evolution of the Eccrina of Glomeris: L. **Léger** and O. **Duboscq.**—A natural mollusc-bearing layer in the Macta, Algeria, and the effect of the nature of the flow of this river on the growth of the molluscs: J. **Bounhiol.**—The ferments of the placenta: MM. **Charrin** and **Goupil.**—The duration of persistence of the activity of the isolated heart: M. **Lambert.**—The influence of old age on the arterial pressure: A. **Moutier.**—A Miocene volcanic chain on the eastern border of the Limagne: Ph. **Glangeaud.**—The discovery of two Cretacean horizons in Morocco: W. **Kilian** and L. **Gentil.**—The grand cañon of Verdon, its age and formation: E. A. **Martel.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—A Discussion of Atmospheric Electric Potential Results at Kew from Selected Days during the Seven Years 1898 to 1904: Dr. C. Chree, F.R.S.—On the Specific Heat of, Heat Flow from, and other Phenomena of the Working Fluid in the Cylinder of the Internal Combustion Engine: Dugald Clerk.

CHEMICAL SOCIETY, at 8.30.—The Interaction of well dried Mixtures of Hydrocarbons and Oxygen: W. A. Bone and G. W. Andrew.—The Explosive Combustion of Hydrocarbons: W. A. Bone and J. Drugman.—The Occurrence of Marsh Gas amongst the Decomposition Products of Certain Nitrogenous Bases as a Source of Error in the Determination of Nitrogen by the Absolute Method: P. Haas.—Studies on Comparative Cryoscopy. Part IV. The Hydrocarbons and their Halogen Derivatives in Phenol Solution: P. W. Robertson.—The Displacement of Acid Radicles. I. Displacement of the Chloride and Nitrate Radicles: A. F. Joseph.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: Francis Darwin, For. Sec. R.S.

LINNEAN SOCIETY, at 8.—Discussion on the Origin of Gymnosperms: Opened by Prof. F. W. Oliver, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Languages of India and the Linguistic Survey: Dr. George A. Grierson.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Record of an Investigation of Earth Temperatures on the Witwatersrand Gold Fields, and their Relation to Deep Level Mining in the Locality: H. F. Marriott.—Note on the Ammonia-Copper-Cyanide Process: E. Le Gay Brereton.—The Cyanide Treatment of Cupriferous Tailings by the Sulphuric Acid Process: W. S. Brown.

FRIDAY, MARCH 16.

ROYAL INSTITUTION, at 9.—How to Improve Telephony: W. Duddell.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Continued Discussion:* Large Locomotive Boilers. G. J. Churchward.—*Probable Paper:* Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: L. Greaven.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Evolution in Relation to Disease: Dr. J. T. C. Nash.

SATURDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof J. J. Thomson, F.R.S.

MONDAY, MARCH 19.

SOCIETY OF ARTS, at 8.—Fire, Fire Risks, and Fire Extinction: Prof Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Economic Geography of Australia: Prof. J. W. Gregory, F.R.S.

VICTORIA INSTITUTE, at 4.30.—The Early Celtic Church of Britain and Ireland: Eleanor H. Hull.

TUESDAY, MARCH 20.

ROYAL INSTITUTION, at 5.—The Influence of Geology on Scenery: Dr. J. E. Marr, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.

ROYAL HORTICULTURAL SOCIETY, Scientific Committee, at 4.—Mendelian Laws of Inheritance: Charles C. Hurst.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Outer Barrier, Hodbarrow Iron Mines, Millom, Cumberland: H. Shelford Bidwell.

MINERALOGICAL SOCIETY.—On the Occurrence of Linarite and Caledonite in Co. Wicklow: Arthur Russell.

WEDNESDAY, MARCH 21.

SOCIETY OF ARTS, at 8.—Motor Boats: Bernard B. Redwood.

GEOLOGICAL SOCIETY, at 8. The Chalk and Drift in Möen: Rev. Edwin Hill.—On the Relations of the Chalk and Boulder-clay near Royston (Hertfordshire): Prof. T. G. Bonney, F.R.S.—Brachiopod Homœomorphy: Pygope, Antinomia, Pygites: S. S. Buckman.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Contribution to our Knowledge of the Rotifera of South Africa: C. F. Rousselet.—On the Resolving Limits for the Telescope and the Microscope: E. M. Nelson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—South Africa as seen by a Meteorologist: Dr. H. R. Mill.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: Recent Advances in Seismology: Prof. J. Milne, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 9.—Imperial Defence: Lord Roberts.

PHYSICAL SOCIETY (University College), at 5.—On Unilateral Electric Conductivity over Damp Surfaces: Prof. F. T. Trouton, F.R.S.—The Construction and Use of Oscillation Valves for Rectifying High Frequency Electric Currents: Prof. J. A. Fleming, F.R.S.—On the Use of the Cymometer for the Determination of Resonance Curves: G. B. Dyke.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Waves: F. K. Stevens.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

CONTENTS

PAGE

THURSDAY, MARCH 22, 1906.

THE BANTU SPEECH OF SOUTHERNMOST AFRICA.

A Grammar of the Kafir Language. By J. McLaren, M.A. Pp. xiv+240. (London: Longmans, Green and Co., 1906.) Price 5s.

A FAIR-MINDED critic would start a review of this work by a general verdict of praise for its compactness and usefulness. It is an excellent grammar of the Kosa[1] language of that southernmost group of Bantu-speaking negroes known unfortunately by the most inappropriate term, the Arab word Kafir, or "Unbeliever." The group of Bantu peoples who inhabit the coastlands of the southern extremity of Africa, between the Transkei River in Cape Colony and Inhambane in the Portuguese Province of Moçambique, had better be styled generically "Zulu" rather than "Kafir" or "Kafir-Zulu."

The name Kafir (which, if it is still to be used, had better be spelt as in Arabic with the single "f") is derived from the Dutch Caffer and the Portuguese Cafre, and these again from the language of the Swahili Arabs whom the Portuguese encountered as the masters and traders of South-eastern Africa in the beginning of the sixteenth century. These Arabs, who radiated from Zanzibar northwards and southwards, called all the negroes south of the Zambezi delta "Kafir" in the singular and "Kufar" in the plural, and by this name they spoke of them to the Portuguese, who at first made use of the Zanzibar Arabs as pilots and guides along the eastern coast of Africa. The Cape Dutch borrowed the term from the Portuguese, and so passed it on to the English.

The great Zulu race at the present day is divided into three main branches so far as language or dialect is concerned—the *Ronga* or *Tonga* section of South-east Africa (including the Abagaza), between Amatongaland and Sofala; the *Zulus* of Zululand, with their outlying colonies and offshoots in Swaziland, Matabeleland, and across the Zambezi (through British Central Africa to German East Africa); and the *Kosa* Kafirs of Western Natal, Pondoland, and the Transkei territories of Cape Colony. The difference between the Zulu and Kosa dialects is much less than between Zulu and Shi-ronga. Naturally, the Zulu speech that has been dropped down here and there in little colonies in East-Central Africa north of the Zambezi is already departing widely from the Zulu in Zululand, owing to intermarriage with local races.

The original place of origin in Central Africa of the Zulu-Kafir peoples and dialects is still an unsolved mystery; their nearest relations at the present day in vocabulary and grammar (though not in phonology) are the great Basuto group of Central South Africa and the Damara (Ova-herero) of South-west Africa. There is not that marked relationship with the existing tongues in Central Zambezia which one would expect to find, though, of course, as these are equally "Bantu" in form and construction they offer a good deal of resemblance to Zulu, but not more so than is shown by the other Bantu languages of East Africa. Here and there in the dialects of Lake Nyasa and even of the tongues of inner East Africa there are hints of resemblances to the Zulu group in vocabulary. At the same time, many of the peculiar features in vocabulary and grammar of the Zulu language and its kindred dialects are only to be met with elsewhere in the Se-suto forms of speech, and perhaps in the Ochi-herero. The Zulu-Kafir language group offers some archaic features in the form of its prefixes and of certain word-roots. But it is *not* the "Sanskrit of the Bantu," nor nearly so archaic as the languages round Tanganyika and the Victoria Nyanza.

One of the most marked peculiarities of Zulu and Kosa Kafir is the possession of three "clicks." The Shi-ronga dialects of South-east Africa, though closely related to Zulu in vocabulary and grammatical structure, do not possess these clicks, and no trace of them is met with in Se-suto or Ochi-herero, or indeed in any other Bantu language. The general assumption is that the clicks have been borrowed from the Hottentots, and, of course, in the case of the Kosa Kafirs this is conceivable, as for centuries they have bordered on the Hottentot domain. Yet it is rather extraordinary that the Basuto peoples, who in history certainly preceded the Kafir-Zulu in the invasion of South Africa, and who, as may be seen by their physical appearance, have anciently inter-bred with the Hottentots, should not have borrowed any click from Hottentot or Bushman. Likewise the Ova-herero and their allies have been in close contact with Hottentot peoples in South-west Africa without catching the infection of the click. Miss A. Werner, one of the few serious students in Great Britain of Bantu languages, has written several articles on this subject, without, however, arriving at a definite conclusion as to whether the Zulu-Kafir clicks are borrowed from Hottentots or are independent developments of the language, recently acquired *in situ*. The author of the work under review seems to suggest that the three Zulu-Kafir clicks may be explosive pronunciations of the gutturals. If so, they might have developed separately without Hottentot influence.

It is a pity in the work before us that the author has not had the courage to quit South African provincialism and aim at bringing his grammar into accord with the approved classification of the Bantu languages, and a system of spelling, such as that of Lepsius, which is both scientific and logical. A strong man should come forward, and, by his influence, compel all philologists, the whole world over, to adopt the Lepsius alphabet (with two or three trifling changes) as the standard which all persons must adopt in transcribing the languages of the world not already and anciently expressed in Roman letters; nay, more, it is to be hoped one day that all the civilised tongues of the world—English, French, German, Russian, Greek, Arabic, and every other speech with a literature—may be written down in one form of lettering, and according to one standard—perhaps the Lepsius—of expressing sounds by letters.

Meantime, some uniformity of transliteration might

[1] It is more convenient to write this word, which begins with a lateral click [=//osa], with a K. It is usually spelt Xosa in South Africa.

well be enforced in Africa. As it is, there is one method adopted in the Western Congo, another in South Africa, a third in East Africa, and a fourth in West Africa and the Sudan. Mr. McLaren, in the Kafir grammar under review, adopts the South African standard; the three clicks which Lepsius expresses by */*, *!*, and *//* are rendered (as they have been for half a century) by *c*, *q*, and *x*.

Now throughout Eastern Africa, *c* or *ch* is used to express the palatal consonantal combination of *tṣ* which in South Africa and many West African missionary grammars is rendered by *tsh*; *q* is universally used in North, North Central, and Western Africa (besides by Lepsius) to transliterate the Arabic ق—*qof*, a very explosive *k*, the old meaning of the Mediterranean *q*. *X* is used by the Congo missionaries (following the Portuguese) as an equivalent for the English *sh* (*ṣ*), and by others as a convenient form of the Greek χ to express the strong guttural *kh* (Scotch and German *ch*). On the other hand, *kh*, *sh*, and *zh* in transliterations into Roman letters of Hindustani and Arabic names are intended to be pronounced literally like an aspirated *k*, *s*, and *z*. It is therefore necessary for a logical orthography to adopt *c*, *q*, and *x* for the purposes above mentioned, namely, to represent the English *ch*, the Arabic ق and the Greek χ. Therefore it would be preferable to render the South African clicks by other signs, such as those proposed by Lepsius.

For the practical purposes of those who wish to acquire the Kafir language or arrive quickly at an understanding of its main features, Mr. McLaren's grammar may be very highly commended.

H. H. JOHNSTON.

MINING LAW.

Mining Law of the British Empire. By Charles J. Alford. Pp. xii+300. (London: Charles Griffin and Co., Ltd., 1906.) Price 8*s*. 6*d*. net.

ALTHOUGH admirable treatises on mining law for the guidance of lawyers have been written by Rogers, Walmesley, McSwinney, Bainbridge, Cockburn, and numerous foreign authors, the field has by no means been exhausted; and Mr. Alford's work forms a welcome addition to technical literature. Written with conspicuous literary skill by a mining engineer of wide experience, it gives a concise summary of the various codes of mining law of the British possessions throughout the world, with well considered remarks on their characteristics. The term mining law is taken by the author to mean the enactments that regulate the acquisition and tenure of mining rights. Mining regulations, which control the methods of working mines, receive merely incidental mention. In the case of Great Britain, it is true, the Mines Regulation Acts are quoted at some length as models; but even in this case no reference is made to the Amendment Act of 1903 or to the numerous special statutes, of which fourteen are cited in Sir C. Le Neve Foster's "Ore and Stone Mining," that affect miners and workers in open pits in this country. Indeed, Mr. Alford's chapter on the mining law of Great Britain is the least striking in the book. Mining in Great Britain is so largely a matter of contract between lord and lessee, and so largely concerned with non-metallic minerals, that there is little scope for the comparative treatment of the metal-mining rights and obligations that forms so interesting a feature of the chapters dealing with colonial laws.

The historical study of the inception of mining law receives, as is to be expected in a book of a purely practical character, only brief mention, and the author has refrained from the temptation of citing the ancient statutes set forth in that delightful old work on mining law, the "Fodinæ Regales" of Sir John Pettus, Knight (1670). Originally, the author tells us, the minerals of the country were worked by slaves or serfs for the benefit of the lords of the soil; and Mr. Alford would have added to the interest of his note on the free miners had he mentioned the fact that the last native-born Briton who was a slave in Great Britain, died in the reign of Queen Victoria. When the Queen ascended the throne, many men and women were still living who had in their youth borne a legal bondage in the collieries of Scotland. Such miners received wages, but were not allowed to move away from their master's estate. They were bought and sold with the property; and although they were freed from their servitude by an Act passed in 1799, the slave taint stuck to their occupation for many years.

Mr. Alford divides his work into nineteen chapters, dealing respectively with the principles of mining law, and with the mining laws of Great Britain, British India, Ceylon, Burma, the Malay Peninsula, British North Borneo, Egypt (should not a word of explanation have been given that Egypt is not a part of the British Empire?), Cyprus, the Dominion of Canada, British Guiana, the Gold Coast, Cape Colony, Natal, the Orange River Colony, the Transvaal Colony, Rhodesia, the Commonwealth of Australia, and New Zealand. An analysis of the mining laws cited shows a grouping of the principles of their construction into two classes:—(1) that in which the State or a private owner of mining property has the right to grant concessions or leases; and (2) that in which any individual, under specified restrictions, has the right to locate a certain limited area of ground or claim and to work or to dispose of it. It is surprising to learn that five-sixths of all the mining areas of the world are worked under the former system of titles. The concession system of large prospecting areas, followed by mining leases of limited areas, of which the present mining law of Egypt is an example, appears to be the most advantageous system of opening up an unexplored country.

As an authoritative statement of the conditions of tenure of mining property under various laws, Mr. Alford's book cannot fail to prove of great value to all connected with mining in the colonies. The work is most carefully and accurately done. There are, however, a few slight omissions; and in order to make the survey of the mining law of the British Empire complete, the author might with advantage

add, when a new edition is called for, a few particulars of the mining law of Newfoundland, the oldest British colony, where copper and iron-ore mining are actively carried on; of the West Indies, where, in Trinidad and Barbados, asphalt mining is of some importance; of British New Guinea, where gold mines are worked; and of Nigeria, where some tin ore is raised.

Bennett H. Brough.

ORGANIC CHEMISTRY APPLIED TO PHYSIOLOGY.

Outlines of Physiological Chemistry. By Dr. S. P. Beebe and Prof. B. H. Buxton. Pp. vii + 195. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 6s. 6d. net.

The book deals chiefly with the theoretical side of organic chemistry as applied to physiology. The first chapter, of twenty-one pages, contains an account of the following matters:—dissociation in solution, nomenclature of acids, chemical equilibrium, catalysis, colloids and crystalloids, colloidal solutions of metals, aggregation, suspension and precipitation, oxidation and reduction, osmotic pressure, calculations of a formula, reasons why reactions take place, graphic formulæ, and ultimate analysis.

It need scarcely be added that the space is entirely inadequate to treat of such a heterogeneous collection of chemical problems, even were it profitable to put them in such juxtaposition. The student who has made any study of general chemistry does not need the chapter, and one who has not will scarcely be able to grasp it in the condensed and jumbled form in which it is here presented to him for the first time.

It would hence have been no loss if the book had commenced with the elementary organic chemistry of chapter ii., so as to leave all the space for this, which is the proper introduction to the subject of the book.

A description of the groups of organic compounds most interesting to the physiological chemist is given in chapters ii. to v., of the proteid molecule, its component parts and disintegration products in chapter vi., of enzymes in chapter vii., and an outline of the antitoxin theory, &c., under the title of "Disease and Immunity," forms chapter viii. and concludes the volume.

This latter part of the book is on the whole well and clearly written, but it might be made much more interesting by the authors breaking, even more frequently than they do, their intention of saying nothing about practical work. A description of organic compounds and their relationships, without any statement of what experiments the knowledge of these relationships is based upon, forms only dry and unprofitable reading. For example, it would be much better if the reader were told how the purin bases, or hexone bases, are separated, and would not have taken up a vast amount of space. Without some such instruction, these bodies are only uninteresting names which weary the reader.

The style of the authors is also such as may encourage a too-realistic belief in the mind of the junior chemist in the graphic formulæ which form the organic chemist's rosary. Thus at the opening of chapter v. there occurs the statement, "The chains of C atoms have a tendency to curl over and join at the two ends, forming in this way a closed chain." At another passage in the volume one reads of "the excretion of benzene rings." The account of the chemistry of the proteid molecule is very clear and well arranged, and this portion of the book may be recommended to the physiological chemist interested in the organic chemistry of proteids.

Benjamin Moore.

OUR BOOK SHELF.

Lectures on the Theory of Functions of Real Variables. Vol. i. By J. Pierpont. Pp. xii + 560. (London and Boston: Ginn and Co., n.d.) Price 20s. net.

This is emphatically a text-book, deductive in method and Euclidean in arrangement; as such, it has the defects of its qualities, but its merits are undeniable. In this volume the author deals with the elementary notions of rational and irrational number, point aggregates, function, continuity, differentiation and integration. The subject last mentioned occupies pp. 333–560, so that conditions of integrability, change of order of integration, upper and lower integrals, &c., receive a proper amount of attention. It should be noted, too, that although it is confessedly incomplete, the discussion of maxima and minima of functions of two or more variables is satisfactory as far as it goes, a most unusual circumstance as things are at present. Perhaps the most valuable feature of novelty is that the author occasionally criticises arguments once thought sufficient, but now known to be fallacious, illustrating by examples the way in which the defective proofs break down. This is an excellent way of making a student feel the necessity of mastering the more refined methods of recent analysis. There is one point in which the author has not quite done justice to his authorities. After explaining Cantor's theory of irrational numbers, he gives a brief sketch of Dedekind's method of partitions, but he does not give this in its genuine form. The essence of a partition is that it divides all *rational* numbers (with the possible exception of one) into two classes, each element of one class being less than each of the other. After this definition it is proved that the aggregate of partitions is continuous. Prof. Pierpont (p. 82) defines a partition as dividing *all* real numbers into two classes; this enables him to use Dedekind's notation, when convenient, but it does not give a just idea of Dedekind's theory, and this is a pity. For bibliographical details the reader is referred to the "Encyclopädie der mathematischen Wissenschaften"; this is all very well for those who have access to that work, but in the interests of the student it would be well to give a list of the most important original sources. It ought to be said that in his preface the author acknowledges his special obligation to Jordan, Stolz, and Vallée-Poussin; at the same time it is evident that he has made use of this and other material in an independent way.

Sound and Rhythm. By W. Edmunds. Pp. xii + 96; and Box of Models of the Human Ear. (London: Baillière, Tindall and Cox, 1906.) Price 2s. 6d. net.

This is an admirable little book. The elements of physiological acoustics are described with remarkable lucidity and accuracy, and there is a wealth of illustra-

tion both in the text and in the diagrams. There are chapters on the nature of sound, waves of sound, musical scales, organ pipes, "time" and movement, the ear, and the voice. Nothing could be happier than the exquisite drawings by Miss Martin Mohun showing an ideal couple—a boy and girl—waltzing and drawing sound curves on the seashore. Mr. Lapidge's diagrams are also excellent. To assist the teacher six models, made by Mr. Lapidge, may be obtained for the illustration of the book for one guinea. These models show the structure of the middle ear and the chain of bones. They are accurate in all anatomical details. The box also contains a nightingale pipe, which is in miniature an adjustable stopped organ-pipe. Mr. Edmunds has succeeded in showing how science may be made interesting to young people. There is a constant appeal to observation and experiment, and the whole subject is treated in such a way as to promote the healthy development of the mental faculties in early life. JOHN G. McKENDRICK.

Historical and Modern Atlas of the British Empire, specially prepared for Students. By C. Grant Robertson and J. G. Bartholomew. Sixty-four plates. (London: Methuen and Co., 1905.) Price 4*s*. 6*d*. net.

Philips' Model Atlas. Fifty Maps and Diagrams in Colour. (London: George Philip and Son, Ltd. n.d.) Price 6*d*. net.

The first of these atlases is full of material designed to show students and teachers how intimately the studies of geography and history are related. The excellently executed plates serve as graphic object-lessons demonstrating the interdependence of cause and effect, and are skilfully conceived with a view to impress various important lessons pictorially. The atlas may be commended to the careful attention of both teachers of geography and history.

The sixpenny atlas of Messrs. Philip gives great prominence to photographic relief maps of the countries dealt with, and these plates will prove of great assistance in enabling young pupils to form mental pictures of the distribution of highlands and lowlands in the countries they are studying, thus providing them with a means to understand the direction of flow of rivers, the distribution of rainfall, and other important geographical features. This wonderfully cheap atlas deserves to be used widely in junior classes.

Natural Science in Hygiene, or the Life-History of the Non-Bacterial Parasites affecting Man. By Dr. James Rodger Watson. Pp. vi+62. (Bristol: John Wright and Co.; London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1905.) Price 1*s*. 6*d*. net.

It is stated in the preface that this little book is intended to place before the student of public health, in a convenient and realistic way, the life-histories of those members of the vegetable and animal kingdoms which by their mode of life are of importance from a public health point of view, and with which he is expected to make himself familiar.

If by "student of public health" is meant the medical man who is going to devote his life to public health, the details given, though on the whole fairly accurate and up to date, are far too meagre and inadequate to be of much service, but the diagrams of life-cycles of the parasites discussed may serve to impress the facts on the memory. The book seems to be more suited to the requirements of the sanitary or meat inspector or health visitor than of the student of hygiene. R. T. HEWLETT.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Plea for Absolute Motion.

The title of Prof. Schuster's letter is somewhat wider than its contents. The writer does not discuss whether the term "absolute motion" is significant, but only whether, assuming that the words have a definite meaning, the absolute motion of any body can be determined by physical inquiry. By implication he has himself answered the question in the negative, for at the critical stage of his discussion he introduces arguments which are not physical, but philosophical.

Prof. Schuster asks, "Does it require explanation that all star groups have the same velocity vector imposed upon them?" Certainly; it requires explanation no more and no less than any other distribution of velocities. It is highly desirable that the equations of the proper motions of the stars should be established and their past history traced until the physical circumstance that determined those motions is discovered. But this circumstance need not be a body at absolute rest. In the analogy which Prof. Schuster gives, the inhabitant of a gaseous molecule would be quite wrong if he decided that the rest of the containing vessel was absolute. Accordingly, Prof. Schuster has recourse to philosophical arguments. We have determined, he says, the velocity relative to a material body which does not come within the range of our observations. I should have thought that the mere fact that we had determined a velocity relative to it proved that it had come within the range of our observations; the deduction from the motion of some of the stars of the existence of dark satellites near them seems an analogous case; and since, he continues, this conclusion is absurd, the body must be replaced by something immaterial. Why is it less absurd to determine a velocity relative to an unknown immaterial than to an unknown material substance? Finally, since the something is immaterial, it cannot be in motion, and therefore it must be at absolute rest. The term immaterial may have many meanings; but I should have thought that an immateriality which precluded a substance from being in motion also precluded it from being at rest. A thought, for example, is incapable of motion, but it is equally incapable of rest; any application to it of the terms motion or rest is not true or false, but simply meaningless.

It may also be pointed out that if the "something at rest" is immaterial, the analogy breaks down. The distribution of the velocities of molecules in a gas depends on the collisions with the walls; but a star cannot collide with an immaterial boundary.

Prof. Schuster says that the attempt to make all motion relative to the æther is inconsistent. With all respect, I do not think he sees the point. The reasons for our preference of the Copernican to the Ptolemaic hypothesis are two-fold. The first reason is that the equations of motion of the solar system are simpler on the former theory. The second reason is precisely that which made the theologians object to the Copernican hypothesis; it points out that it is the sun, and not the earth, which holds a unique place in the solar system; this is a question of scientific taste. There are the same reasons for referring all motions to axes fixed in the æther—if we could determine them. Firstly, an attempt is being made to reduce all laws to electrodynamic laws, and these are simplest on the basis of a fixed æther. Secondly, the æther holds such a unique place in the physical universe that it is desirable to direct attention to the fact. The question of the "absolute motion of the æther"—if any—cannot come within the range of physical discussion any more than the "absolute motion of the sun" can come within the range of any discussion based on the properties of the solar system.

I should like to add a few remarks on the subject of "absolute rotation." "Rotation," it seems to me, like

"expansion" or "shear," is not the name of a distinct kind of motion—it is only a term introduced to abbreviate the discussion of a particular and important case of the relative translation of the particles of a body. Direct kinematical statements can only be made concerning particles of infinitesimal volume; such particles can only have translation, they cannot rotate. When bodies of finite volume are considered, they are analysed into particles the motions of which are then investigated. If there is no relative translation between the particles the motion is said to be pure translation; if there is relative translation the motion is said to be partly, or wholly, rotational. It is the characteristic of rotation that two particles situated on a straight line through the "axis of rotation" possess a relative acceleration along that line, and it is by the existence of these accelerations that absolute rotation is detected. If we can find a line such that any two particles situated on a line intersecting it are subject to relative accelerations along the latter, the body is said to rotate. It would be impossible for any observer on a rigid body to detect its rotation, for the relative accelerations of its particles could not be observed. If Foucault's pendulum were rigidly attached to the earth, or if the water in Newton's bucket were frozen, no observers on the earth or the bucket having cognisance of these bodies only could detect the "absolute rotation." In fact, the absolute rotation of bodies of finite volume is only a special case of the relative translation of particles.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, March 18.

Interpretation of Meteorological Records.

THE series of curves given by Messrs. Lander and Smith's instruments, and published in NATURE of March 15, are most interesting, and one cannot help looking for the cause of the close relation between the movements of all the five instruments. It is with the view of offering an explanation of the sympathy between these instruments that the following lines are written. If I might venture to suggest a first cause of these movements, I would say it was the thunderstorm that drew the trigger which started all of them. The thunderstorm gave rise to a heavy fall of rain—a quarter of an inch in a few minutes—and this rainfall appears to have been the cause of the movement of all the instruments, and instead of being placed last in the series should have been put first. The effect of a heavy local fall of rain is to cause a down rush of air, the air being dragged downwards by the falling rain. This downward moving mass of air checks the wind, because its movement is at right-angles to the wind, hence the drop in the wind-velocity curve. The wind not being able to pursue its course gets deflected—in this case the curve shows it was to the north-west. The down rush of air where it meets the surface of the earth has its velocity reduced and direction of movement changed; its pressure is therefore increased, and the barograph shows that the pressure increased by the tenth of an inch. The downward rush of air would bring the air from the upper strata to the surface of the earth, and as this upper air would be in all probability the colder, it would cause a fall in the temperature, which the thermograph shows amounted to twelve degrees.

On one occasion I had an opportunity of seeing this downward movement of air produced by local rain. It was while making some meteorological observations on the top of the Eiffel Tower, in Paris. At first the weather was fine, and the dust-counter showed that the impure city air came to that height in great quantities. After a time a heavy shower came on which reduced the number of particles in the air, and at last the air became as free from dust as any air I have ever tested on the mountain tops of Switzerland. This increase in purity could only be due to the rain dragging down the upper purer air to the level of the top of the tower, as rain cannot wash the air to anything like that purity.

If the time scale of the curves in the instruments had been a good deal wider, and all the clocks going together, one could have found out whether the above explanation was correct or not, as we would expect the rainfall curve to begin first and all the others to follow, but from the closeness of the time scale of the curves no satisfactory information on this point can be obtained.

Ardenlea, Falkirk, N.B. JOHN AITKEN.

Agricultural Education and Colonial Development.

IN your issue of January 11 reference is made to the requirement which has recently arisen for specialists in agriculture and the allied sciences for employment in the British colonies and dependencies. The case, so far as India is concerned, may be stated very briefly. The Government is willing to spend money in the development of agricultural education and research, but the efficient recruitment of the department—or, more properly, departments, for there are eight local governments in India and Burma, each of which will have its own separate agricultural department—is not an easy matter. The educated native of India has not hitherto devoted the interest to the study of agriculture that he has to law and medicine, and men qualified to give instruction or conduct investigations in relation to this national industry are not to be found in the country. It is quite unnecessary to raise the question as to whether they will be obtainable in the future. This is one of the great desires of the Indian Government. In the meantime, however, men qualified to fill the offices above indicated are required, and a search has to be made elsewhere. In this respect, then, India appears to be drawing upon the same market as other countries.

In my view, the description of man that is required is one possessing a thorough knowledge of *principles*. The conditions of tropical agriculture are so very different from those of the British Isles that it is highly desirable for the Britisher to commence work in other continents with as open a mind as possible. I am not thinking so much of the agriculturist as of the botanist, entomologist, or chemist. Just as the chemist who has made himself master of pure chemistry makes eventually the best technical chemist, and finds it, indeed, easier to apply himself to any special technology than the so-called technical chemist, so, likewise, for agriculture in foreign countries, the men who will be most useful in the future will be those who have obtained a thorough knowledge of their particular science at college without any special reference to British agriculture. J. WALTER LEATHER.

Agricultural Research Institute, Pusa, Bengal, February 28.

Peculiar Ice Formation.

IN reply to Mr. James Foulds's inquiry in NATURE (March 15, p. 464) whether the prismatic forms of ice such as he has recently observed in Lancashire have been observed elsewhere, it may suffice to refer him to previous volumes of NATURE, more particularly to vols. xxxi. and xlvii., for letters from Messrs. Woodd-Smyth and McGee, also from myself. In the latter volume is an account by me of a more extended series of observations on these "crystallites" than previous observers appear to have made. Friability of soils is due to interstitial water.

Bishop's Stortford, March 16. A. IRVING.

I OBSERVED the same formation as that described by Mr. Foulds (p. 464) on bare soil, previously soaked with water, near Champéry, in Switzerland, as winter frosts began; and I believe that I have observed it everywhere as a common phenomenon.

I take it that the wet surface is first frozen, and that, as the cold penetrates, the ice exudes from the soil much as lanoline exudes from a lanoline tube, the water expanding as it freezes, and so forcing its way out between the more compact masses of soil, lifting the frozen surface-sheet.

The first touch of sun caused the structure to break up.

It struck me at the time that this was the cause of the injurious effect of frost on the surface of roads considered from the cyclist's point of view. W. LARDEN.

Devonport, March 16.

AMERICAN OBSERVATIONS OF THE TOTAL SOLAR ECLIPSES OF 1900 AND 1901.[1]

IN the year 1900 the moon's shadow swept across the southern portion of the United States of America, travelling from New Orleans, through Georgia, South and North Carolina, and leaving this continent at Cape Henry, in Chesapeake Bay. After traversing the Atlantic Ocean the shadow crossed Spain, and cut the African coast at Algiers.

The large strip of country in America over which the shadow passed drew a great number of American observers to this region, and in a volume which has quite recently been published we have a detailed account of the observations and photographs.

For the main part, this valuable addition to eclipse literature deals with the observations made by the Naval Observatory, which equipped two stations on the central line, one in North Carolina and the other in Georgia, the intention being to duplicate the work in order to minimise the danger of unfavourable weather. Since, however, a large number of other parties with varied equipments was scattered along the line of totality, the reports of several of these have been included in a separate section of this volume.

The stations fixed upon by the Naval Observatory's parties were two in the State of Georgia, namely, Barnesville and Griffin, and one in North Carolina, Pinehurst being the location selected. The reason why two stations were chosen in the former State was because it was desirable to concentrate the spectroscopic attack on the chromosphere near the end of the shadow track, Griffin being the region where the lower strata of the sun's atmosphere during totality were exposed longer to view. Griffin was twenty miles distant from Barnesville. Prof. Updegraff was placed in charge of the Georgia stations, while Prof. Skinner superintended the work at Pinehurst.

Fortunately the weather was very favourable at all the stations, so that the results here brought together are numerous and very complete. First, as regards the instrumental equipment at each of the stations. Space does not permit reference to the instruments in anything like detail, but the reader will find in the volume all the information clearly set out. The general scope of the work undertaken will, nevertheless, be gathered from the following brief summary concerning the chief instruments employed.

Barnesville.—This station was chiefly used for photographing the corona. The largest instrument employed there was an object-glass of 4-inch aperture and 40-feet focal length, the tube being pointed directly at the sun at eclipse time. The image formed was 4.36 inches in diameter.

Another instrument consisted of a battery of cameras mounted on a wooden polar axis 11 feet long and moved by a clepsydra. The cameras erected on this were as follows:—three lenses of 6-inch aperture having focal lengths of 104, 80, and 33 inches; a 4-inch Dallmeyer lens of 17-inch focal length; and a 3.5-inch Dallmeyer of 9.5-inch focal length.

In addition, there were two 5-inch equatorials for visual observations and a prism-spectrograph.

Griffin.—At this station the attack was made from the spectroscopic point of view. Here were located a 10-feet concave Rowland grating worked in conjunction with a 3.5-inch quartz lens and a cœlostat; the plates used were placed in curved backs, and the first-order spectrum was employed. There was also a large Rowland concave grating of 21.5-feet radius, worked also in connection with a quartz lens and cœlostat, but mounted after the method of Rowland. This was employed chiefly for the ultra-violet in the second-order spectrum.

Pinehurst.—Here was erected a 5-inch 40-feet coronagraph pointed directly at the eclipsed sun. Worked in connection with three independent cœlostats were:—a plane grating objective spectrograph with ruled surface 3.5 × 5 inches (15,000 lines to an inch); a concave (10-feet) grating slit spectrograph similar in ruling and size to the plane one; and a 4-inch prismatic camera with one flint glass prism of 60°.

As at Barnesville, a large polar axis was here erected to carry several cameras, and two Dallmeyer lenses of 38-inch focal length and a Voigtländer lens were mounted on it. Three equatorials for visual observations and a transit instrument completed the equipment.

FIG. 1.—The coronas of 1900 (upper) and 1901 (lower) as photographed by the U.S. Naval Observatory parties. (The north point of the sun is at top of each.)

In the volume before us the results obtained with each of the several instruments are individually discussed, and on the whole they have turned out very satisfactory. Further, the volume is illustrated, not only by a series of excellent reproductions from photographs of the camps and the instruments *in situ*, but of the forms of the corona and the chromospheric

[1] "Publications of the U.S. Naval Observatory." Second Series, vol. vi, appendix i. By Rear-Admiral Colby M. Chester, U.S.N., Superintendent. Washington, 1905.)

spectrum. All these will be of great interest to other observers of the same eclipse, as comparison of results is of great importance in the interest of future eclipse work.

It would lead one too far, and, indeed, it is not necessary, to enter into the very complete treatment here published of the various branches of work so well brought together, but perhaps a word or two may be mentioned with regard to some expectations that were not so successfully realised as was hoped.

In the case of the 10-feet concave grating erected at Griffin, the plates turned out to be very much under-exposed. In explanation of this, Prof. Crew not only summarises the possible causes of failure, but adds some useful suggestions for use on future occasions. In the case of the former he mentions seven possible causes, the first being that the intensity of radiation of the eclipsed sun was underestimated, and consequently only the very brightest lines of the chromospheric spectrum were recorded. The second was that the effect of astigmatism in the curved grating was underestimated.

A third reason was that an exposure of two plates instead of one during totality was more than was justified by the dispersion and slit width.

In Mr. Humphrey's report relative to the 21.5-feet Rowland grating at Griffin, a very dissatisfied tone is pronounced with regard to the instrument's efficiency. He finally states:—"It does not seem probable, however, that a grating mounted according to the Rowland method and used with a slit can, even under the most favourable circumstances, yield nearly as many flash lines as may be obtained with a prism or a concave grating used directly without lens or slit. . . . It would be well in using a spectrograph of this kind to avoid the chromatic aberration of lenses entirely and to form the image on the slit by means of suitable reflectors. It might also be best to use silver reflectors and to avoid that part of the ultra-violet of wave-length shorter than λ 3600. Direct grating or prism spectrographs should be used, if possible without reflectors of any kind, but when a reflector is used it should consist of magnalium for the ultra-violet and of silver for light of longer wave-lengths."

With regard to the plane grating spectrograph used at Pinehurst, Mr. Jewell states that the definition of the lines was good from wave-length 3850 to 4100, and "remarkably fine near the H and K lines." The definition between 3750 and 3850, and from 4100 to 4200, is described as "fair," but "very poor" at wave-lengths less than 3700 and greater than 4200. A complete and long table of wave-lengths of the chromospheric lines measured is given in the report.

The coronal lines observed were six in number, the mean wave-lengths of which were as follows:—3382.4, 3453.3, 3644.0, 3801.8, 3987.5, and 5304.1. The objective prism spectrograph at the same station also secured chromospheric and coronal spectra, and although a long list of the wave-lengths of the lines is published, great weight cannot be given to their accuracy, since the definition on the negative is described as "poor over the whole spectrogram and particularly poor for the violet end."

Although no word has yet been said about other branches of work taken up, the reader must be referred to the volume itself for the numerous reports on them. We reproduce in Fig. 1 (upper part) a picture of the corona as photographed with the 40-feet camera at Barnesville, the exposure of which lasted thirty-five seconds. It will be seen that it illustrates well the "wind-vane" form typical at epochs of sun-spot minimum. The lower part of this illustration shows the corona of 1901, taken also with the 40-feet instrument. Fig. 2 shows a general view of the station selected at Pinehurst, the method of supporting the 40-feet coronagraph, and the houses for the other instruments erected there.

FIG. 2.—The U.S. Naval Observatory Eclipse Station at Pinehurst, North Carolina. The 40-foot Coronagraph is on the left.

The second portion of this important volume deals with the observations made during the solar eclipse in Sumatra in May, 1901, the stations selected being Solok, Fort de Kock, and Sawah Loento. At the first station clouds reigned supreme during totality, but the chromosphere was photographed at third contact through clouds. At the second station the weather is described as "perfect," while the observers

at the third station only managed to obtain some results at third contact, the weather being very unfavourable.

At Fort de Kock, in addition to some beautiful corona pictures (one of which is here reproduced for comparison in Fig. 1) taken with the 40-feet coronagraph, used horizontally in this eclipse, photographs were secured with the 30-feet concave grating. In the latter, films were used in consequence of the sharp curve in the focal plane of the grating, but, as the report says, "each film showed that, unfortunately, it had not been placed exactly in focus, still the dispersion was so great that many of the lines could be very easily identified." A table is given showing the results obtained from the measures of these negatives, the spectrum covering λ 3118·5 to λ 5204·7; intensities, character, and wave-lengths from Rowland's tables are also included.

At Sawah Loento the plane grating proved a success, parallel rays falling on its surface and being brought to a focus on the photographic plate by means of a lens placed between the grating and the plate. In spite of clouds, the negative taken at third contact is said to have been fully exposed. The large dispersion employed and the definition obtained allowed very accurate wave-lengths to be deduced, so that the table of wave-lengths extending from λ 3835·2 to λ 4957·8 will be very valuable to compare with those made by other observers.

The discussion of these results is here carried to some length, but space does not permit of any extensive reference. It may, in the first place, be said that both Mr. Jewell and Dr. S. A. Mitchell record having observed the magnesium (λ 4481) line in the photograph of the chromospheric spectrum, and both agree in the determination of the wave-length, intensity, and length of arc. It is described as being stronger in the chromospheric spectrum than in the ordinary solar spectrum. The presence or absence of this line in the chromospheric spectrum is a point of such great importance that the observation above described requires to be very carefully corroborated before it can be finally accepted. It is, however, very difficult to understand how the above identification of the magnesium line with the chromospheric line has been obtained, because in the list of wave-lengths here published the evidence seems to point to a titanium origin. Thus we find in this table that the wave-length of the chromospheric line, as measured, is λ 4481·4, while the solar lines nearest this are, according to Rowland, λ 4481·298 (Mg) and λ 4481·438 (Ti). Further, has it been definitely established that the solar line λ 4481·298 is due to magnesium?

It is also stated that it seems probable that the more volatile gases of atmospheric air uncondensed at the temperature of liquid hydrogen, together with hydrogen, helium, neon, and argon, are present in the chromosphere, but with regard to krypton and xenon the evidence is not conclusive. These deductions also do not seem to be supported by sufficient evidence, but will require further discussion before they can be generally accepted.

Enough, perhaps, has been said to indicate to the reader the importance to the study of solar physics of the publication of such a volume as this. Here we have all the data and discussions relative to two eclipses brought together under one cover, rendering a comparison of results a matter of little labour. One blemish we may, however, remark, and that is that the corona reproductions are not oriented in any way.

It may be still in the minds of our readers that, for the observation of the recent eclipse of 1905, Admiral Chester, Commander-in-Chief U.S. Eclipse Squadron, was in command of four men-of-war told off for eclipse work in Algeria and Spain. Their "station bills," showing the staff at each station and the work to be accomplished, gave one a good idea of the thoroughness with which the undertaking was organised. We shall at any rate look forward to another such volume as this, with, we hope, equally successful results. WILLIAM J. S. LOCKYER.

AGRICULTURE AND THE EMPIRE.

NATURE for January 11 contains a short paper on a large subject. Seeing that the cultivation of the soil, or agriculture, is the fundamental condition of human existence with any approach to civilisation, large is a very moderate description.

I take it that the object of the writer was to discuss the part that the Home Country should play in advancing agriculture in the Empire at large. That is a matter which seems to me important enough to receive a little discussion. It is one with which I have been a good deal occupied during the past thirty years. I should like, therefore, to attempt to define the present position of the problem a little more precisely.

May I begin with a very obvious remark? Agriculture is a sort of "noun of multitude." There is undoubtedly only one agricultural science based on physiological principles; there are many agricultural "arts" based on the application of that science, whether empirical or otherwise, to widely different physical conditions. The agriculture of the Lothians differs widely from that of Bengal, and both differ from that possible on the Gold Coast. This will seem to many an absurdly trite remark. Nevertheless, experience shows that it represents a fact which has often been overlooked, with loss and disappointment as the result.

It may, I think, be confidently stated that arable cultivation has been brought in the British Isles to a pitch of perfection which is not surpassed anywhere in the world. It is, however, an "intensive" and highly specialised agriculture. This is readily illustrated by the yield of wheat per acre. On land of prairie value, where the nitrogen removed is balanced by that received from the atmosphere, it has been shown at Rothamsted that the yield is roughly some 10 bushels or less. This actually represents the state of things in the great wheat-growing countries from which we draw our supplies—Argentina, Australia, India and Russia—and the United States with 13 bushels are not much better. The yield of the United Kingdom for the five years preceding 1904 was 31 bushels, and this was only surpassed by that of our antipodal colony New Zealand, 32.

This is largely due to the scientific research in agriculture for which, I think, it may be fairly claimed this country has always been preeminent. I by no means think that it is exhausted. I remember Sir John Lawes saying to me that, having devoted half a century to the study of the soil actually cultivated, he was still absolutely ignorant as to the subsoil and the part played by it. Our knowledge of the action of manures is mainly empirical, and we have still to learn much of its physiological significance. Without this it cannot be said that we possess a rational theory of manuring. Farmers must have wasted enormous sums in the application of nitrogenous manures until Frankland showed that a considerable proportion passed off unused in the drain-water.

I must confess that I am not clear that the arable agriculture of the United Kingdom is in a backward condition, that it does not compare favourably with that of other countries, or that it stands in urgent

need of Government aid in regard to research. Its theoretical principles can be taught in our universities and schools; its practice can only be learnt on the farm. While saying this I must also express my conviction that the agricultural wealth of this country might be increased in many ways. In my evidence before the recent departmental committee on fruit culture I expressed a strong opinion that the condition of that industry was in no way creditable to us.

At the moment, where, so to speak, the shoe pinches is not above but below. There is no dearth of scientific knowledge in the country, but it floats on the surface and does not permeate. The scientific and even practical ignorance of the small cultivator is profound. The Board of Agriculture and Fisheries has tried to grapple with this by the wholesale distribution of carefully prepared leaflets. But such a method of disseminating knowledge is of almost heart-breaking difficulty. I have had prepared at Kew a series of diagrams illustrating the diseases of trees, suitable for schools. The *Daily Graphic* was good enough to say that:—"This publication is equal to the very best of those ever sent out by the United States Department of Agriculture." Yet the sale has been disappointing, and the Board of Agriculture and Fisheries does not see its way in consequence to proceed with the further and still more needed series dealing with the diseases of fruit trees. The crying need, in my judgment, at the moment is the introduction of intelligent cultural instruction into rural elementary schools.

If we turn to India we have to face a difficult problem. The revenue is dependent on the land, and this in turn has to support a constantly increasing population. It has been supposed that this might be met by the use of British methods. But how? Sir James Caird, who was sent out to study the problem on the spot, reported that if the produce of the land could be increased by 1 bushel per acre, all would be well. No doubt; but how is this intensive cultivation to be accomplished? Long cultivation has brought the land down to a condition of nitrogen-equilibrium. Dung is used as fuel, and the cultivator is too poor to import artificial manures.

In 1900 I attended a conference at the India Office on the qualifications of an Inspector-General of Agriculture. The report of the proceedings is printed in the Blue-book of the Botanical Work Committee (pp. 77–78). I stated then, and the statement met with general assent, "It would be the greatest mistake to substitute for Indian agricultural practices western methods, merely because they had succeeded in the west. . . . The problem in India was how best to graft the results of scientific agricultural knowledge on to the stock (the really valuable stock) of Indian agricultural practice and experience."

India has long had experimental farms in plenty. They have not been without their usefulness. But they have lacked permanence and a guiding principle. It now owes in great measure to the munificence of an American gentleman an agricultural research institute at Pusa. It is further, I believe, intended to establish a number of subordinate stations at a cost of 250,000*l*. If these are to be staffed from home *forthwith*, the result will be very much what the Transvaal Director of Agriculture points out. The Government of India should at once make up its mind what appointments it proposes ultimately to make, and inform the universities at home five years in advance. Students at the universities cannot be expected to engage in agricultural or allied studies unless they see clearly what is to come of it at the end.

Let me turn now to the problem presented by the West Indies and other of our tropical possessions. Sir Daniel Morris is quoted as saying in regard to the former:—"Agricultural education is at the root of the successful development of these Colonies." This is perfectly true, only I rather doubt whether the writer of the article quite understood the reason. In temperate countries agriculture is a necessity of existence; in many tropical countries it is not. The wasteful production of a few ground provisions calls for the minimum of effort, and is sufficient to sustain indolence. But with the introduction of orderly government a revenue becomes necessary. Sir Charles Bruce has laid it down that "in the Crown Colonies generally . . . the only taxable fund is the wage fund supplied by the annual proceeds of the cultivation of the land" (Proc. Colonial Institute, vol. xxxvi., p. 248). To induce the negro to engage in profitable cultivation instead of contenting himself with a bare modicum of ground provisions provides a source of revenue, raises his standard of comfort, and makes for his moral progress. But he has to be taught by example how to do it, and this is the agricultural education which Sir Daniel Morris had in his mind. It is widely different from anything of the kind in this country.

In point of fact, tropical agriculture has little relation to that of temperate countries. Its methods are those of horticulture; it is essentially extended gardening. For the supply of men for this purpose our agricultural colleges would be of little or no use. The problem has had to be met in a wholly different way. The machinery for the purpose is compendiously described in the following extract from the Colonial Office List (p. xx.):—"'Botanic Stations' . . . are small and inexpensive gardens, devised in 1885, in order to afford practical instruction in the cultivation of tropical crops, and were intended to develop the agricultural resources at first of the smaller West Indian Islands, and subsequently (1887) of British possessions in Tropical Africa. Each is in charge of a Curator, who is a gardener trained at Kew."

The sort of success that has attended the system may be illustrated by a single example. Cacao was introduced to the Gold Coast from Kew. In 1891 the export was valued at 4*l*. In 1900 I was able to exhibit at the Paris Exhibition from the botanic station the first sample, to the best of my belief, grown on the African continent, when it received a bronze medal. In 1904 the export had risen to a value of more than 200,000*l*. In effect, cacao is exchanged for imported goods; besides thus adding to the comfort of the cultivators, it enables them to pay the taxes necessary to maintain peaceful government.

For work of this kind the Empire has to depend on Kew, which is organised for the purpose as an advanced horticultural school. At the present moment some seventy Kew men are in official employment and carrying on the work I have described in our various tropical colonies and possessions.

But besides native peasant cultures British capital and enterprise are also largely embarked in the tropical regions of the Empire in "planting industries." These meet with difficulties which the local Government can and does supply skilled aid to mitigate. Most of the West Indian colonies have a "Government analyst." Cambridge has secured the traditional right to train and supply these. Incidentally they are able to give important aid in dealing with agricultural problems. The value of the work done by Prof. Harrison in British Guiana and Prof. d'Albuquerque in Barbados can hardly be over-estimated.

Ceylon possesses an almost unique staff of trained

experts of every kind at Peradeniya, and a similar organisation is in process of establishment in the Federated Malay States. The rubber industry of the Straits Settlements owes its success to the Director of Public Gardens at Singapore. Besides Pusa, India has experienced botanical experts, all university men, at Calcutta, Madras, and Saharunpore.

Our self-governing colonies know pretty well how to take care of themselves. All possess agricultural departments and produce journals which will compare more than favourably with anything at home. In Canada the Central Experimental Farm at Ottawa is certainly not eclipsed by any institution in the United States. I may be pardoned a little vanity if I remark that when the Transvaal Government applied to Washington for an agrostologist it received a Kew man.

To sum up. What the Home Country can supply to the Empire is :—(1) cultural instructors such as are trained for the purpose at Kew; (2) men with a sound scientific training and a firm grasp of the principles underlying agricultural practice of whatever kind, and for these we must look to the universities. Men who are merely familiar with British agricultural conditions will be mostly of little use unless they possess the flexibility of mind which will apply theory to new and unfamiliar conditions.

W. T. Thiselton-Dyer.

NOTES.

The position of the South Africa medal fund for the endowment of a medal and scholarship or studentship in commemoration of the visit of the British Association to South Africa in 1905 is stated in a circular just issued by Prof. J. Perry, honorary treasurer to the fund. The subscriptions promised or paid amounted to 752*l.*; and to this the council of the British Association has resolved to add the unexpended balance of the special South African fund, amounting to about 800*l.* The following report of the executive committee was adopted at a meeting of subscribers on March 2, and approved by the council of the British Association :—(*a*) That the fund be devoted to the preparation of a die for a medal to be struck in bronze, $2\frac{1}{2}$ inches in diameter, and that the balance be invested and the annual income held in trust; (*b*) that the medal and income of the fund be awarded by the South African Association for the Advancement of Science for achievement and promise in scientific research in South Africa; (*c*) that, so far as circumstances admit, the award be made annually. It is to be hoped that a fund raised for so excellent a project will receive a substantial increase from members of the association who have not already contributed to it, or from subscribers who may wish to add to their subscriptions.

The terrible mine explosion at Courrières, in the Pas de Calais, on the morning of March 10, involving the loss of about 1200 lives, has naturally led to all sorts of conjectures as to the immediate cause. As usual, atmospheric conditions are said to have played a not unimportant part in bringing about the tragedy. In some mysterious way the very low barometric pressure over the North Sea on March 12, two days later, is supposed to explain the disaster. If, however, attention is concentrated on the atmospheric conditions prevailing at the time of the accident, it will be found that they resembled those which have accompanied the majority of the great disasters of the past fifty years. The *Bulletin météorologique de France* shows that during the night of March 9 a well marked anticyclone extended from Spain in a north-easterly direction across France and the Netherlands, so that at 7 a.m. on March 10, when the calamity occurred, the barometer over the Lens district had risen to 765 mm. (30·1 inches); it had, in fact, mounted nearly a quarter of an inch in the course of the night. Obviously, if atmospheric pressure played any part in bringing about the catastrophe, the latter cannot in any way be associated with a low and falling barometer.

The death of Mr. William Sowerby, for many years secretary of the Royal Botanic Society, Regent's Park, occurred at his residence in Hertfordshire on March 9. A grandson of James Sowerby, the famous illustrator of "English Botany" and of "British Conchology," and son of James de Carle Sowerby, another gifted naturalist, Mr. W. Sowerby inherited the family taste for natural history. He was responsible for the drawing of some botanical plates, but early in life he became associated with the Royal Botanic Society through his father, who was a founder and the first secretary, and in Regent's Park he worked for half a century. An observation which brought his name prominently before the public was the discovery of a medusa in the Victoria Regia tank, this being the first record of a medusa in fresh water, not to say in a most unexpected locality. He was keenly interested in economic plants, and not only did he bring together a unique collection, but he obtained fruit and fibre, the latter being distributed on several occasions to commercial men for trial. Among his successful experiments was the cultivation of the white mangrove, Avicennia, that flourished and produced aërial roots in artificial brackish water; he also demonstrated that seaweeds could be grown in tanks in the greenhouses.

It is reported from Tokio that a severe earthquake has occurred at Kagi, in Formosa. Many hundreds of persons have been killed and injured, and a large number of buildings have been destroyed.

A Reuter message from New York states that, according to advices from Honolulu, a volcano in Savaii Island (Samoa) is in eruption on a large scale. Three villages have been completely destroyed, including Maleda. The lava stream is three-quarters of a mile wide, and is flowing into the sea.

Dr. H. C. Bastian, F.R.S., gave a demonstration, with the aid of lantern slides, "On some Heterogenetic Processes," on March 15 at the rooms of the Medical Society. Various micro-organisms were exhibited with the view of meeting the objections that have been raised to Dr. Bastian's interpretations of the transformations observed. An account of Dr. Bastian's remarks is given in the *Lancet* for March 17.

The secretary of the Decimal Association informs us that he has within the past few days received fifty-three promises of support from newly elected members of Parliament. In the last parliament there were 330 members pledged to support the adoption of the metric weights and measures in this country, and at the present time 253 votes can be relied upon in the House of Commons. Additional assents are being received day by day, and it is probable that when the canvass now proceeding has been completed there will be as many supporters in the present parliament as there were in the last.

The report of the late Dr. S. P. Langley, secretary of the Smithsonian Institution, Washington, for the year ending June 30, 1905, shows that much valuable scientific

work is accomplished year by year as a result of the grants made by the institution from the Hodgkins fund administered by it. One such piece of research is that in connection with speech or phonetics, by Dr. E. W. Scripture, who has secured individual gramophone voice records of much historical interest. A voice record of the German Emperor was transmitted by Dr. Scripture in January, 1905, for preservation in the United States National Museum. This record gives, in about 200 words, the Emperor's conception of the aims and beauty of true manhood and of man's duty to his fellow. It is stated that at present only one other record of the Emperor's voice exists, namely, one made at the same time for preservation in the library of Harvard University. Among other important researches aided by the Hodgkins fund may be mentioned the investigations of the upper air currents by means of kites by Dr. A. L. Rotch, of Blue Hill Meteorological Observatory; the experiments conducted by Mr. Alexander Larsen, of Chicago, in connection with the photography of lightning flashes and the fluorescence of minerals; the serial instantaneous photographic study of the flight organs of animals, by Dr. von Lendenfeld; and Prof. W. P. Bradley's experimental investigation of the expansion of air through a nozzle.

The amphipod crustaceans of Catherine Bay, Murman coast, form the subject of an illustrated paper by Mr. E. van der Brüggen published in the last issue of *Trudui* of the St. Petersburg Academy for 1905.

A paper on Californian reptiles, by Dr. S. E. Meek, just issued by the Field Columbian Museum, contains descriptions, with figures, of two species of rattlesnake regarded as new, as well as notes on a number of other snakes and lizards.

We have received from the Field Columbian Museum at Chicago a copy of a "Check-list of Mammals of the North American Continent, the West Indies, and the Neighbouring Seas," compiled by Dr. D. G. Elliot, and issued by the museum. This bulky volume purports to include the names of all species of mammals inhabiting America as far south as Colombia that have been described up to the date of publication. It is, in fact, supplementary to the author's two previous synopses of American mammals.

"The Ideal Thoroughbred Stud" forms the subject of No. 8 of Rural Studies Series, this being the title of a lecture by the Rev. E. A. Woodruffe-Peacock, the well known specialist on soils and grass-lands. With a full knowledge of most large English stud-farms, the author expresses his opinion that there is not one which has not at least some deficiency; and after pointing out the lines on which an ideal stud should be formed, he observes that "the birthplace of a long and steady series of race-winners cannot be a matter of mere chance."

The March number of the *Naturalist* contains an attractive coloured plate representing a pair of bearded tits in their native marsh. The contents include Mr. G. W. Lamplugh's presidential address to the Northern Naturalists' Union at Bradford on January 27, having for its subject the necessity for the amateur spirit in scientific work. Attention is directed not only to the valuable work accomplished by amateurs in the past, but also to the many fields in which their assistance is of the utmost importance at the present day. As an instance, the official geologist cannot possibly devote long periods of time to particular sections or pits, whereas an amateur living in the neighbourhood can easily do so, and thereby is not unfrequently able to solve a problem which has been inexplicable to his professional brother.

The programme of the July conference of the Museums Association at Bristol is outlined in the February issue of the *Museums Journal*. Among the articles is one by Mr. H. Bolton on the future of museums, being the report of a paper read at last year's conference. The author urges the advisability of a Government grant being paid annually to provincial museums of first-class standing, in return for which such institutions should be severally expected to perform a certain amount of allotted work, and in all instances to maintain a high standard of excellence. Another address at the same meeting, by Mr. S. L. Mosley, had for its subject museums and private collections, the author pointing out how much good a private collector can do by working for a museum, and how much harm when seeking his own ends.

In the opening article in the February number of the *American Naturalist* Dr. H. Ayers, taking for his text "the unity of the gnathostome type," urges that there is neither anatomical nor embryological ground for removing amphioxus from the vertebrate class, and that we may class this creature as the sole representative of the Acrania, in contrast to the Craniata, which includes all the rest. Not only so, but the discovery by the author of rudimentary jaw-structures in the lampreys renders the division of the Craniata into Cyclostomata and Gnathostomata no longer tenable. The Gnathostomata must comprise, therefore, the Marsipobranchi as well as all the forms previously included, so that all Craniata are Gnathostomes. The origin of the craniofacial apparatus is thus to be sought in the missing links between amphioxus and the Craniata. Old age in brachiopods, by Dr. H. W. Shymer, and the habits of the American spotted salamander, *Necturus maculosus*, by Prof. A. C. Eycleshymer, form the subjects of the other two articles in the same issue.

Science of February 16 contains a report of an address delivered by Dr. C. H. Merriam, as vice-president and chairman of the zoological section, at the New Orleans meeting of the American Association for the Advancement of Science, on the question whether mutation is a factor in the evolution of the higher vertebrates. As the result of a long practical acquaintance with American mammals, Dr. Merriam is of opinion that there is no evidence of origin by mutation (sudden marked variation) in this class, but that everything points to variation by insensible degrees. Here the author takes occasion to mention that among mammals there is abundant evidence of the gradation of one species or race into another, so much so that specific or racial separation of specimens is often difficult. While admitting that in rare instances species of plants may arise by the perpetuation of "sports," Dr. Merriam states his contention to be that "the overwhelming majority of plants, and so far as known, all animals, originate in the generally recognised way, by the gradual development of minute variations."

It is encouraging to notice the growing appreciation on the part of Government departments and colonial administrators of the benefits to be derived from the application of scientific methods under expert guidance to pearl and other fishery industries. In the proposal to lease the pearl fisheries to a company for a period of twenty years recently laid by the Governor of Ceylon, Sir Henry Blake, before his Legislative Council, it was expressly stipulated "that

a sum of not less than Rs. 50,000 be expended annually on the scientific development of the banks." The Torres Straits pearl-shell fisheries, it seems likely, will also be put under scientific control and cultivation. In a report by Mr. W. Saville-Kent to the Queensland Government (1905) it is shown that the pearling industry to the north of Australia is in a depressed condition due to over-depletion of the natural shell-beds, so that they can no longer be worked at a profit. Mere closure of the beds against fishing is regarded as an inadequate measure, since the remaining molluscs are too few and too scattered to ensure sufficiently rapid propagation to re-populate the ground in a reasonable time. Mr. Saville-Kent recalls what is known of the breeding habits of the animals, and of their suitability for transplantation, and recommends the establishment of at least six "Government pearl-shell breeding reserves" at what seem to be suitable spots in the Torres Straits area. At each reserve about 1000 adult pearl oysters will be kept for breeding purposes enclosed in frames of wire-netting, and Mr. Saville-Kent is of opinion that "within a period of three or four years . . . the adjacent waters within many miles from these breeding centres should be restocked with young shell to such an extent as to permit of profitable fishing." He also recommends the establishment of an experimental cultivation laboratory on the small islet of Wai Weer at Thursday Island, and suggests, further, that a consignment of the Ceylon pearl oyster should be laid down on the Torres Straits ground. It is evident that a good deal in the way of scientific cultivation could also be done by collecting the spat and by cultching the ground, and that regulations may be required in regard to public and private fishing on the beds, and the proper treatment of the stock in the Government reserves. The adoption, before it is too late, of such scientific methods is probably the only way of restoring a depleted pearl-shell industry.

The progress of Indian agriculture has hitherto been recorded in such publications as the Agricultural Ledger issued by the Reporter on Economic Products, or the bulletins circulated by certain of the provincial Governments; and reports on agricultural experiments have been included in official reports dealing chiefly with land records and administrative questions. The existing methods of publication were not suited to the altered conditions produced by the activity of the new department organised by Mr. James Mollison, first Inspector-General of Agriculture in India, and all interested in Indian agriculture will welcome the news that the Imperial and provincial Departments of Agriculture will henceforth publish a "Journal" and "Memoirs." The first number of the Journal has just been issued from the Agricultural Research Institute at Pusa. It is edited by the Inspector-General with the assistance of the Pusa staff, and will be published quarterly. The present number contains an interesting account of the development of the Indian Departments of Agriculture by Mr. F. G. Sly, officiating Inspector-General, and seven articles on questions connected with the cultivation of sugar-cane, cotton, and other Indian staples. The intention of the Government is that the Journal shall deal with agricultural subjects which are of interest to general readers—crops, insect pests, cattle breeding, irrigation, cooperative credit—while in a second publication, to be entitled "Memoirs of the Department of Agriculture in India," scientific work in agricultural chemistry, botany, &c., will be recorded. The Memoirs will be published as separate articles, and these will be arranged in series. Separate series will be issued for each of the chief divisions of science. Both publications will be freely illustrated.

A very valuable report by Dr. A. C. Houston on the bacteriological examination of milk has been issued by the London County Council, with a preface by Sir Shirley Murphy. The report is based on the examination of (*a*) twenty samples of specially selected milk from twenty separate healthy cows; (*b*) twenty samples of milk collected from purveyors' shops; (*c*) twenty samples collected from dairy shops; (*d*) twenty samples collected from churns at railway stations; and (*e*) twenty samples collected from the establishments of well known milk dealers. The samples under (*a*) served as a standard, while those under (*b*) and (*c*) were of milks of indifferent quality, in the main collected from poor neighbourhoods and premises known to be ill-adapted for the sale of milk. The various sources of pollution of milk are enumerated, and an important recommendation is made with regard to a temperature standard, viz. that all milk should be rapidly cooled below 10° C. and maintained at or below this temperature during the whole period of transit and sale in order to prevent the multiplication of bacteria. The following bacteriological standards are suggested:—(1) 1 c.cm. should not give evidence of the presence of *B. enteritidis sporogenes*; (2) 0·001 c.cm. should not give evidence of the presence of *B. coli*. (3) 0·0001 c.cm. should not give evidence of the presence of streptococci; (4) the primary sediments (after twenty-four hours) should not exceed 100 parts per 1,000,000; (5) the secondary sediment (after centrifugalisation) should not exceed 50 parts per 1,000,000. Finally, several reforms which may be considered immediately practicable are suggested for dealing with the milking, the conveyance of the milk, and the vending of the same.

An editorial article in the *Indian Forester* (January) advocates the formation of forest museums in each forest division or in each province that may contain several divisions. In Europe the inception of such a scheme is found in Saxony, where each forest conservator is provided with a set of mounted specimens of the chief insect pests with instructions for dealing with them. In India the credit of starting collections of timber specimens and other forest produce for a conservator's museum is due to Mr. Gass, of the Coimbatore division, Madras. The collections for this division have been extended to serve for the three circles of the presidency, and a special building has been sanctioned for the purpose.

In consequence of the drought that was experienced during the season 1904–5, particularly in Antigua, the experiments arranged by Dr. F. Watts on the chemical selection of sugar-canes in the Leeward Islands failed, but the experiments with different varieties of sugar-cane were carried out. In the report published as a separate part by the Imperial Department of Agriculture for the West Indies it is noted that the six canes giving the best results in Antigua were the same as in the previous year, thus confirming the good character of these canes. The experiments in St. Kitts did not agree so closely with those of previous years, this, no doubt, being caused by the irregularity of the rainfall in different districts.

At a research meeting of the Royal Geographical Society on March 9, a paper was read by Mr. J. L. Myres on the Alpine races in Europe. Rejecting Prof. Keane's theory of a North African origin, Mr. Myres said that the brachycephaly of the Alpine stock might have been de-

veloped locally, or might have immigrated from western Asia, but there was no reason to suppose that the area in which the race occurs in Europe was large enough or secluded enough to account for so considerable a change. The northern or steppe route into Europe was not available until the retreat of the ice-cap and the shrinkage of the Caspian, but south of the Black Sea there was a route, now concealed by submergences subsequent to the period with which he was dealing. In Anatolia the conditions were favourable for the development of a distinct type, and at the same time south-east Europe was partially isolated, and its climate rendered it little suitable for human habitation. *Homo alpinus* was tall in Albania, short in Central France; the dwarf broad-heads developed in south-eastern Europe, where the climate was severe, the giant broad-heads in Anatolia, where conditions were more favourable; and it was natural to find the latter to the east of the former, for they were driven out of Anatolia later, leaving scattered "Dinaric" populations east of the Sea of Azov, and throwing out colonies beyond the "Cevenoles." In favour of this hypothesis were the facts that (1) the fruit-culture of the European lake-dwelling peoples was characteristically Anatolian; (2) physically they were of the right type; and (3) even in classical times Anatolia was noted for this type of dwelling.

At the eighth International Geographical Congress, Mr. R. De C. Ward, of Harvard University, contributed a useful paper on a more rational treatment of climatology. He pointed out that the method of presenting climatic data in the usual tabulated form is unsatisfactory, because it does not bring out the cyclonic variations of different weather conditions experienced from day to day. He does not suggest any change in the recognised order of presentation, but he urges that wherever possible the cyclonic unit should be made the basis of summaries, as well as the diurnal, the monthly, the seasonal, and the annual unit; also that much more attention should be paid to an adequate verbal discussion. Over the greater portion of the equatorial zone, weather and climate are almost synonymous terms, but in the temperate zone, for instance, the regular diurnal changes are very frequently overshadowed by the changes due to the passage of cyclones and anticyclones. The author gives several clear illustrations, *e.g.* in mean monthly and mean annual ranges of temperature we have the sum of both periodic and non-periodic changes which occur during any month, irrespective of the question whether the maxima and minima all occurred under similar conditions, and thus we lose sight of a very important factor in climate; and similarly with regard to rainfall and other elements. More attention should be given to seasonal averages, to departures from the means, and even to the single occurrence of certain phenomena. A tribute is paid to the more rational treatment of climatology as evidenced by the beautiful charts by Dr. Buchan in Bartholomew's "Atlas of Meteorology"; but, valuable as such charts are, the author considers that the various weather elements which, taken together, make up climate should be summarised, not on the basis of the year or month only, but of the cyclone which controls them.

The Journal of the Royal Sanitary Institute (No. 1, 1906) contains an interesting paper by Dr. W. N. Shaw, read before the conference on smoke abatement, and entitled "Is London Fog Inevitable?" The author pointed out that we do not know the actual course of events in the physical processes comprised in the origin and persistence of fog, and referred to two important inquiries made under the superintendence of the Meteorological Council relating to the winters of 1901–2 and 1902–3. In the first report Captain Carpenter came to the conclusion that in winter London was never free from a smoke haze; for some months St. Paul's was invisible from the Victoria Tower at the times of observation, although in the following year conditions were more favourable. The most frequent cause of fog is the cooling of the surface by radiation under a clear sky; there is no limit to the extent of country that may be affected by the formation of fog under this condition. In the second winter, 1902–3, Mr. Lempfert assigned twenty-four cases out of thirty-nine dealt with to the effect of radiation, while eight were considered to consist practically of smoke alone. Thus about 20 per cent. of the London fogs in that year might have been avoided by the abatement of coal smoke, while the remainder depended upon physical processes which are beyond our control. Dr. Shaw remarks that one of the unsolved problems of this interesting subject is why the sun's heat does not dissipate the fog upon which it shines. It was found that the sunshine recorder at Bunhill Row during the month of December lost 83 per cent. of the sun's burning power, that at Westminster 61 per cent., and that at Kew 15 per cent., so that if the sun has any substantial power of dissipating early morning fog, the smoke of the London atmosphere must seriously interfere with its effect. The peculiar manner in which the density varies from place to place, and various other points about London fog, await further investigation.

The Geological Survey of Alabama has issued a revised map of the south-eastern part of the Cahaba coalfield, embodying the results of investigations made since the publication of the original map in 1890. The vertical section shows fifteen seams, mostly of small size, in about 1800 feet of measures.

Statistics of the quantity and value of each of the important minerals raised in India have been published by Mr. T. H. Holland, F.R.S., in the Records of the Geological Survey of India (1906, part i.). Compared with 1903, an increase of nearly 7 per cent. is shown in the total value of mineral production. The production of coal, 8,216,706 tons, exceeded all previous records. There were also produced 3596 tons of chromite, 286 carats of diamonds, 618,746 oz. of gold, 3256 tons of graphite, 3778 cwt. of jadeite, 1315 tons of magnesite, 150,297 tons of manganese ore, 19,575 cwt. of mica, 118,491,382 gallons of petroleum, 265,901 carats of rubies, 1,170,205 tons of salt, 315,558 cwt. of refined saltpetre, and 1388 cwt. of tin ore. Statistics of the production of alum, amber, asbestos, borax, building stone, clay, gypsum, limestone, marble, ochre, and slate are incomplete.

In the Records of the Geological Survey of India (vol. xxxiii., part i.) Mr. E. Vredenburg deals with Pleistocene movement as indicated by irregularities of gradient of the Narbada and other rivers in the Indian peninsula. He gives a very striking photograph of the falls of the Narbada at Dhári. Recent changes in the course of the Nam-tu River, in the northern Shan States, are described by Mr. T. D. La Touche, and the same author gives a note on the natural bridge in the Gokteik Gorge, advantage of which was taken in selecting a site for the railway bridge on the Mandalay-Lashio line. Lastly, Mr. P. N. Bose gives an account of the geology and mineral resources of the Narnaul district, in the Patiala State. The minerals

of economic value met with include iron ores, mica, copper ores, manganese, rutile, as well as limestone and other building stones.

IT has always been a difficult matter to obtain pure lithium by the electrolysis of fused lithium chloride, which has been the method employed up to the present, and was originally used by Bunsen. In the *Zeitschrift fur Elektrochemie* of March 9, Messrs. O. Ruff and O. Johannsen describe a process which they have satisfactorily worked out for its preparation by the electrolysis of lithium bromide. They prepare the lithium bromide by the action of hydrobromic acid on the carbonate. The electrolysing vessel is of copper, and is partially water-jacketed in order that the walls may be kept cool and thus protected by a coating of solid lithium bromide. The anode is of retort carbon, and the two kathodes of iron wire 4 mm. in diameter. The electrolyte consists of lithium bromide containing 15 per cent. of lithium chloride. A current of 100 amperes at 10 volts is employed, and the yield of metallic lithium is about 80 per cent. of the theory. From time to time the metal as it collects on the iron kathode is removed with a flat iron spoon, and at once placed on a cold stone surface, where it rapidly solidifies. Determinations of the melting point showed it to be 180°, which agrees with that found by Bunsen in the middle of the last century.

A SIMPLE arrangement for purifying mercury which is likely to prove of considerable service is described by Messrs. G. A. Hulett and H. D. Minchin in the *Physical Review* (vol. xxi., No. 6). The method consists in distilling the mercury in a Wurtz flask under diminished pressure, allowing bubbles of air to pass through the mercury during distillation so as to prevent bumping. The air also serves the very useful purpose of oxidising any metallic impurity, such as zinc, cadmium, or lead, which otherwise would contaminate the distillate. Ordinary distillation *in vacuo* of mercury containing one of these metals does not suffice to remove the impurity, but by using the method described an amalgam of zinc can be made to yield pure mercury in a single distillation. An electrical method of ascertaining the presence of one part of zinc in ten billion parts of mercury is described incidentally.

THE March number of the *Geographical Journal* contains an interesting table by Miss Nora E. MacMunn, compiled from planimetric measurements made on an orographical map at the School of Geography, Oxford, showing the areas of the orographical regions of England and Wales. As a rule, the plains have been measured to the 250-feet contour line, and the hills have not been considered to begin below that level. The average height of England and Wales, calculated from these measurements, is 385 feet. Of the total 58,324·3 square miles constituting the area of England and Wales, 26,481·6, or 45·4 per cent., are under 250 feet in elevation; 16,364·5, or 28 per cent., are between 250 feet and 500 feet; 10,476·3, or 18 per cent., are between 500 feet and 1000 feet; 4698·3, or 8 per cent., are between 1000 feet and 2000 feet; 300·0, or 0·5 per cent., are between 2000 feet and 3000 feet; and 3·6 are more than 3000 feet above sea-level.

MR. FROWDE is about to publish for the Radcliffe trustees a "Catalogue of 1772 Stars, chiefly comprised within the Zone 85°–90° N.P.D., for the Epoch 1900," deduced from observations made at the Radcliffe Observatory, Oxford, during the years 1894–1903, under the direction of Dr. A. A. Rambaut, F.R.S.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET (1906*c*).—A telegram from Kiel announces the discovery of a new comet by Mr. Ross, of Melbourne, on March 18.

Its position at 7h. 36·1m. (Melbourne M.T.) was

$$\text{R.A.} = 2\text{h. } 3\text{m. } 52\text{s., dec.} = \;\; 7° \; 41',$$

which is about half-way between ζ and o Ceti.

A second telegram from Kiel states that Mr. Morgan observed the comet at Glasgow (U.S.A.) on March 19. Its position at 7h. 40·9m. (Glasgow M.T.) was

$$\text{R.A.} = 2\text{h. } 9\text{m. } 31{\cdot}4\text{s., dec.} = -5° \; 47' \; 25''.$$

The comet is stated to be of about the eighth magnitude.

COMET 1906*b*.—Numerous observations of comet 1906*b* are reported in No. 4078 of the *Astronomische Nachrichten*.

Observing at Bamberg on March 4, the day after its discovery, Prof. Hartwig found that the comet had a diameter of about 10″ and a central condensation of about magnitude 11·0. The same magnitude was recorded by Dr. Wirtz at Strassburg on March 6.

Prof. Max Wolf reports that the comet is easily seen on his plates, and shows a tail of about half a degree in length; with the 10-inch refractor a sharp nucleus was observed on March 4, and it was seen that the tail extended to the north-west.

COMET 1906*a* (BROOKS).—In No. 4078 of the *Astronomische Nachrichten* Herr M. Ebell gives a further daily ephemeris for comet 1906*a*, extending from March 16 to May 3. The following is an extract therefrom:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log r	log Δ	Brightness
Mar. 20	5 41 5	+46 31	0·2618	0·1986	0·25
24	5 42 18	+43 47	0·2710	0·2284	0·21
28	5 43 58	+41 23	0·2801	0·2567	0·18
April 1	5 45 57	+39 18	0·2891	0·2835	0·15
5	5 48 10	+37 27	0·2981	0·3088	0·13
9	5 50 34	+35 48	0·3069	0·3325	0·11

Brightness on January 27 = 1·0 = about 10·0 m.

Observing at Arcetri on January 31, Dr. Abetti found that the comet had a central nucleus of about the tenth magnitude or a little greater, and that the surrounding nebulosity extended for about 2′, chiefly towards the direction of lesser right ascension.

On March 22 this comet will pass near to β Aurigæ, about 11m. (R.A.) to the west, whilst on April 5 it will be only about 5m. west of θ Aurigæ.

A PROGRAMME OF SOLAR RESEARCH.—Now that the Mount Wilson Solar Observatory has fairly settled down to work, Prof. Hale has revised his "Programme of Solar Research," published several years ago, and gives an outline of the revised programme in No. 1, vol. xxiii., of the *Astrophysical Journal*.

Two principal studies are to be prosecuted. First, a study of the sun as a typical star, with reference to stellar evolution; secondly, the relationship between solar and terrestrial phenomena.

These studies are divided into five groups, each of which contains a number of subdivisions. The five main groups are:—(1) direct photography; (2) spectroheliograph researches; (3) spectroscopic investigations; (4) studies of the total solar radiation; and (5) allied laboratory investigations.

Most of these are now being prosecuted at Mount Wilson, and Prof. Hale points out that there are many other solar investigations which call for attention, and of which many may be carried out by amateur observers with modest equipments.

HARVARD COLLEGE OBSERVATORY.—Prof. Pickering's report of the work done at Harvard College Observatory during the year ending September 30, 1905, is the sixtieth of the series, and contains the record of an immense amount of work, too much even to summarise here.

One or two special features may, however, be mentioned. Eighteen eclipses of Jupiter's satellites and eight occultations of stars by the moon were observed with the 11-inch Draper telescope. Three of the occultations were photo-

graphed continuously on a revolving plate, so that the nature of the disappearance, whether instantaneous or gradual, could be recorded.

Numerous valuable observations of peculiar stellar spectra were made during the year, including the discovery of Nova Aquilæ No. 2 by Mrs. Fleming. This is the eighth Nova discovered by that observer from the Draper memorial spectrograms.

With the Bruce telescope 523 plates were obtained, making 7504 in all, from which Miss Leavitt has discovered 1129 new variable stars during the year.

The bibliography of variable stars compiled by Miss Cannon was nearly ready for publication when the Astronomische Gesellschaft appointed a committee to undertake a similar work. Prof. Pickering therefore proposes to publish the Harvard work in an abridged form.

CATALOGUE OF 3799 BRIGHT STARS.—A useful catalogue of 3799 bright stars has just been published by M. J. Bossert, of the Paris Observatory.

This catalogue gives the magnitude and mean coordinates (1900·0) of each star, and, in addition, the precession, secular variation, and proper movement, together with instructions and examples for finding the star's position at any given epoch.

The stars are arranged in zones of 1° of N.P.D., and in each zone they are given in order of R.A., this classification being considered the most convenient for meridian observers.

Stars down to the seventh magnitude are included, the magnitude of Aldebaran being taken as 1·0.

ECLIPSE OBSERVATIONS AT CATANIA.—On the occasion of the total solar eclipse of August 30, 1905, observations of prominences, by the Lockyer-Janssen method, and of the variations in the terrestrial electric field were carried out, during the whole day, at the Catania Observatory.

The results are published in No. 1, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani*, and show, among other things, that the maximum effect of the solar radiation corresponds to the minimum potential of the atmospheric electricity.

MICROMETER MEASURES OF STRUVE DOUBLE STARS.—No. 4078 of the *Astronomische Nachrichten* contains the results of a series of measures of eighty-one "Struve" double stars made by Dr. H. E. Lau, of the Copenhagen University Observatory.

The position for 1900·0, the position-angle, the distance, and the data and hour of each observation are given for each star, and are followed by brief notes by the observer.

SOME APPLICATIONS OF THE THEORY OF ELECTRIC DISCHARGE THROUGH GASES TO SPECTROSCOPY.[1]

THE luminosity produced by an electric current passing through a gas at low pressure varies greatly in character, not only when we alter the nature of the discharge, as, for example, when we pass from the arc to the spark, but also in many cases at different points of the same discharge. The luminosity may be of one colour at one place and of a very different colour at another, and spectroscopic examination shows that the spectrum of the same gas often varies considerably as we proceed along the line of discharge. As recent experiments have thrown a considerable amount of light on the processes going on in the different kinds of electrical discharge and at different parts of the same discharge, the study of the connection between the changes in the electrical effects and the changes in the spectra might be expected to throw some light on the very interesting question of the genesis of spectra. Many important points can very conveniently be studied by the aid of Wehnelt's method of producing the current. In this method the kathode is a strip of platinum or a piece of platinum wire on which either a little lime or barium oxide has been deposited. This when heated to redness emits large supplies of corpuscles, and by altering the temperature of the platinum very large variations in the current passing through the tube and in the potential difference between the electrodes can be obtained. In our experiments the current varied from a small fraction of a milliampere to several amperes, and the potential difference from a few volts to several hundred.

The apparatus used is shown in Fig. 1. AB is the platinum strip with the lime on it; a thermocouple—a platinum and platinum-rhodium junction—was fused to this strip, and served to determine its temperature; the strip was connected with the earth, and was heated by a current passing through the leads LM; a rheostat was placed in series with the heating current, and by means of this the temperature could be altered gradually. The anode was a platinum disc; this was connected with the positive pole of a battery of storage cells, the negative pole of which was earthed; to allow of gradual variations in the potential difference between the electrodes a potential divider of 100 resistances of 10 ohms each was used. The current through the tube was measured by a d'Arsonval galvanometer, and the potential difference between the terminals by a Weston's voltmeter.

Some of the most interesting features of the discharge are very prominent when the temperature of the platinum is high, say 1400° C., and the pressure of the gas low, less than 0·01 mm. of mercury. The discharge is light

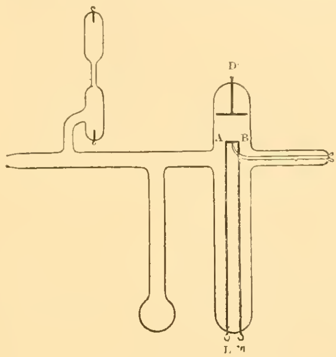


FIG. 1

blue, and its spectrum shows the mercury lines and the band spectrum of nitrogen. In this case the relation between the current and the potential difference is represented by a curve like Fig. 2, the ordinates representing the current and the abscissæ the potential difference. In the case we are considering, when the wire is very hot and the pressure low, the change from the dark to the luminous discharge takes place very abruptly, an increase of the potential difference by 1/100 of a volt being often sufficient to convert a discharge where no light could be detected even in a darkened room into one where the light was quite bright. When luminosity appears there is a very rapid increase in the current; in some of the experiments an increase in the potential difference of 1/100 of a volt increased the current forty-fold. At this stage the thermojunction showed that there was no increase in the temperature of the platinum where the luminosity appeared; we shall see later on that it is possible by using large potential differences to get such large currents through the tube that the platinum becomes appreciably warmer by the passage of the current.

One point which I think very suggestive is the abruptness with which the luminosity round the kathode appears. We see that by a very small increase in the potential difference the discharge passes from a state in which no luminosity can be detected, even in a dark room, to one where the luminosity can plainly be seen in a bright light; thus the molecules of the gas in the tube, just when the luminous discharge is on the point of appearing, are in a state in which a very small change in the electrical

[1] Discourse delivered at the Royal Institution on Friday, January 19, by Prof. J. J. Thomson, F.R.S.

conditions of the tube makes the molecules pass from a condition in which they are not giving out an appreciable amount of light to one where they are brightly luminous, and, as the great increase of the current when the luminosity appears shows, this change in state is accompanied by an emission of corpuscles. From this and other considerations I have come to the conclusion that what takes place when the gas becomes luminous is that the

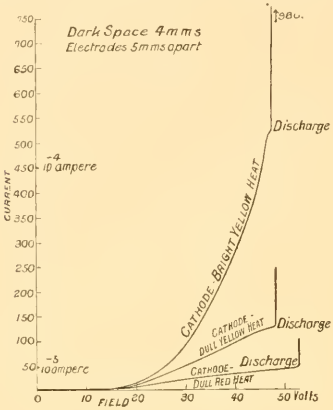


FIG. 2.

internal energy in the atom, in consequence of its bombardment by the corpuscles, increases, and when it gets up to a certain critical value the equilibrium of the atom becomes unstable, an explosion occurs resulting in an expulsion of corpuscles, and such a shaking up of those left in the atom that these vibrate so vigorously that the energy radiated is sufficient to produce luminosity. Thus I regard the ionisation of the gas as being due, not to the corpuscles in the atom being dragged out by the direct action of the electric forces in the field, or as being knocked out by a rapidly moving corpuscle striking against them, but to an explosion due to the atom having absorbed so much internal energy that its equilibrium becomes unstable. Other phenomena point to this as the method by which ionisation is effected. If the corpuscles are dragged out of the atoms by the electric field, the velocity with which they are projected should depend upon the strength of the field; while if they are projected by an explosion their velocity would depend only upon the nature of the atom, and not upon the strength of the field. Now when Röntgen rays fall upon a substance the atoms of the substance are ionised, and corpuscles are emitted forming a stream of kathodic rays. Barkla has lately shown, however, that the penetrating power of the kathodic rays produced in this way is independent of the intensity of the Röntgen rays. Now the electric force in the Röntgen rays depends upon their intensity, and the penetrating power of the kathodic rays depends upon their velocity, so that this result shows that the velocity of the corpuscles does not depend upon the intensity of the force acting upon them. Again, Lenard has shown that the velocity of the corpuscles ejected when ultra-violet light falls upon a metal is independent of the intensity of the light. Lenard also investigated the secondary kathode rays produced when kathode rays fall upon matter, and found that, in addition to rays the velocity of which was of the same order as that of the primary rays, and which may be regarded as deflected primary rays, there were other very slow rays, and the measurements he gives indicate that the velocity of these varies but little from that of the primary rays.

A point of great importance which can easily be shown by this apparatus is that the stage at which luminosity sets in depends upon the current density through the tube, and not merely upon the potential difference. One way of showing this is to lower the temperature of the platinum, keeping all the other conditions the same, and again determine the relation between the current and the potential difference. The effect of lowering the temperature is to reduce the number of corpuscles starting from the kathode, so that with the same potential difference the current density is smaller. If the relation between the current and potential difference is represented by a curve such as Fig. 3, it will be seen at once that the lower curve cannot be deduced from the upper curve by reducing all the ordinates in the same proportion. The critical points on the curves, *i.e.* the place where ionisation by collision begins and where the luminous discharge appears, are at very different potentials: the greater the current density the smaller the potential difference corresponding to these critical points. Thus, to take a case actually observed. When the wire was very hot the discharge was brightly luminous with a potential of 24 volts; on lowering the temperature no luminosity could be detected with a potential difference of 110 volts.

We can also show the effect of current density without altering the temperature of the kathode by placing near the tube an electromagnet so arranged that its lines of magnetic force in the discharge tube are along the line joining the kathode and the anode; the effect of the magnetic field is to make the corpuscles move along the lines of force, and thus without altering the number of corpuscles emitted by the kathode it concentrates their paths and so increases the maximum current density in the tube. When the magnet is on, ionisation by collision and luminosity both occur at a much lower potential difference than when it is off, and it is easy to arrange matters so that, keeping the potential difference constant, the discharge is luminous when the magnet is on and dark when it is off. When the potential difference is too small to produce a bright discharge even when the magnet is on, the current through the tube is often greater when the magnet is on than when it is off. By placing the magnet so that the lines of magnetic force are across the line joining the kathode to the anode we can render the paths of the

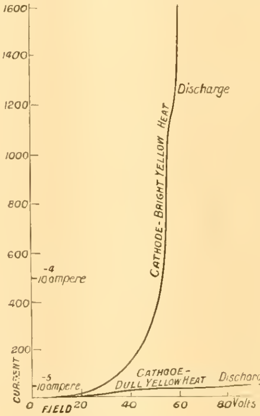


FIG. 3.

corpuscles more diffuse than they would be without the field, so that the maximum current density is less when the magnet is on than when it is off; in this case it requires a larger potential difference to produce a luminous discharge with the magnet on than with it off. Similar effects produced by a magnet on another kind of discharge are described in my "Recent Researches," p. 105.

The potential difference P just where the glow commences, when the pressure is low, sometimes varies so rapidly with the current i as to be roughly inversely proportional to it. The following are some values of i and P for a gas at a constant low pressure as the temperature of the platinum strip was increased; the numbers are in the order of increasing temperature:—

i (in scale divisions)	P (volts)	Pi
6	60	360
8·7	40	348
11·2	30	336
14	25	350

Such a simple relation between P and i is, however, exceptional.

The fact that the potential differences at which ionisation by collision or luminosity begins depend upon the current density, shows that the ionisation or luminosity of an atom need not, and, indeed, cannot entirely, be the result of a *single* collision between a corpuscle and the atom. For if that were the case, then since the energy of the corpuscle depends only upon the electric field, and not upon the current density, the effect of increasing the current density would merely be to increase in the same proportion the number of luminous atoms, while, as a matter of fact, if the potential difference is kept constant and the current increased by raising the temperature of the platinum strip the increase in the luminosity is greater out of all proportion than the increase in the strength of the current.

The result, however, is easily explained if we look at the question from the following point of view. Suppose that for ionisation or luminosity to take place the internal energy of the atom must increase by certain amounts, say E_1, E_2 respectively. Then, if the energy possessed by the corpuscle were very great, the result of one collision with an atom might be to give to the atom enough energy to ionise it or make it luminous, or both. But even if the corpuscle were less energetic, and did not in one collision give enough internal energy to the atom to ionise it, it would communicate some energy to it, and if the atom had any power of storing up energy this would form a contribution towards the critical amount of energy required by the atom before it is ionised. The atom, after having had this energy communicated to it, would, so long as it retained any of it, not require so much energy to ionise it as before. The atom, too, might acquire energy, not merely by corpuscles striking against itself, but also by the collision of corpuscles with neighbouring atoms; such collisions generate soft Röntgen rays, the energy of which might be absorbed by the atom under consideration and help to raise its energy to the critical point; the energy in the Röntgen rays might by itself raise the internal energy of the atom to this value, or else raise it so nearly to this value that the collision with a corpuscle would give it enough energy to carry it past the critical stage. The rate at which the energy, due to collisions of corpuscles with itself or with neighbouring atoms, comes to an atom will be proportional to the rate at which energy is being communicated to the gas, *i.e.* to Fi, where F is the electric force and i the current density, and thus for a constant electric force would be proportional to the current density. The atom will radiate away some of its internal energy; if the rate of this radiation is proportional to the amount of energy, E, possessed by the atom, say equal to βE, then if q is the rate at which energy is being communicated to the atom, we have

$$dE/dt = q - \beta E,$$

so if E vanishes with t,

$$E = q/\beta\,(1 - e^{-\beta t}).$$

Thus q/β is the limit to the energy acquired by the atom, and this is proportional to q, while q is proportional to Fi, so that the atom will acquire the critical amount of energy or not according as Fi is greater or less than a certain value.

Application of these Results to Spectroscopy.—We have seen that the passage from the dark to the luminous discharge occurs with great abruptness, an increase of the potential difference by 1/100 of a volt being sufficient in certain circumstances to convert a discharge in which no luminosity at all could be detected to one where it was quite bright. This suggests that the luminosity sets in when the internal energy of the atom, or rather of that part of it which gives rise to the particular kind of light present in the luminous discharge, attains a perfectly definite value. This way of regarding the origin of the luminosity affords a very simple explanation of the variation of the spectrum with the kind of discharge and of the effect of introducing capacity or self-induction into the circuit containing the discharge tube. Let us consider the rise in energy of a vibrating system inside the atom; let E be the energy at the time t, α the rate at which it is absorbing the work done in the discharge tube; the energy may be supplied to it from the Röntgen radiation in the tube or from the corpuscles which come into collision with the atom, α will be proportional to the rate at which the electric field producing the discharge is doing work in the neighbourhood of the atom we are considering; it will thus be proportional to the product of the electric force and the flux of corpuscles in this neighbourhood. Let us suppose that the system radiates energy at a rate proportional to E, say equal to βE, then we have

$$dE/dt = \alpha - \beta E,$$

or

$$E = \alpha/\beta\,(1 - e^{-\beta t})$$

if $E = 0$ when $t = 0$.

Consider two different systems, A and B, in the same atom; let E_1, α_1, β_1; E_2 α_2, β_2 be the values of E, α, β for the systems A and B respectively.

$$E_1 = \alpha_1/\beta_1\,(1 - e^{-\beta_1 t}),$$
$$E_2 = \alpha_2/\beta_2\,(1 - e^{-\beta_2 t}).$$

Now suppose that the system A is one that does not absorb much, but also does not radiate much, while B absorbs a great deal more than A, but radiates still

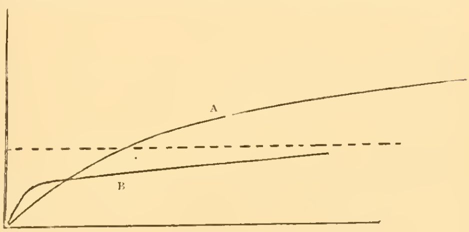


Fig. 4.

more in proportion, so that $\alpha_2 > \alpha_1$ but $\alpha_1/\beta_1 > \alpha_2/\beta_2$, then ultimately E_1 is greater than E_2, but at first E_2 is greater than E_1. The curves A and B, Fig. 4, represent the variations of E_1 and E_2 with the time.

Suppose, now, that systems A and B become luminous when the internal energy is equal to W. It is not necessary to assume that the critical amount of energy is the same for the two systems; the assumption is only made to simplify the diagram; it will be seen that the argument will apply if the critical amounts of energy are different in the two cases.

Now consider, first, the case when the rate at which work is being done in the tube is so small that though α_1/β_1 is greater than W, α_2/β_2 is less than W, the case represented in Fig. 4; here system A acquires the amount of energy necessary to make it luminous, while system B does not; thus in this case the spectrum of the gas would show the lines corresponding to A, but not those of B. Suppose, now, we increase the rate at which work is done in the tube, so that both α_2/β_2 and α_1/β_1 are greater than W, the case represented in Fig. 5.

Here the system B attains the critical amount of energy, and it reaches this value before A does so, so that in this case the lines of B will be visible. Let us now consider the lines in the spectrum corresponding to the system A; these will be visible if the energy in the system reaches the critical value. The conditions in this case are in some respects more unfavourable for the supply of energy to

this system than they were in the previous one. For in the first case the system B got into the condition in which it radiated as much energy as it received, and thus did not absorb any of the energy; in the second case, however, B became luminous before its radiation was equal to the absorption; it is thus taking in more energy than it gives out, and this may result in a diminution in the rate of supply of energy to A. It would be so, for example, to a marked extent if the conditions were such that A received a considerable portion of its supply of energy from B; this diminution in the supply might be great enough to prevent the internal energy in B reaching the critical value. Thus the effect of the increase on the rate of supply of the electrical energy might be to weaken, or even obliterate, the lines of A, and while with the smaller rate we had the lines of A and not those of B, with the larger rate we might have the lines of B and not those of A; thus an increase in the rate at which the electric field is doing work such as would be produced by increasing the current through the discharge tube might result in an entire change of the spectrum. We should expect that it would only be in exceptional cases that the lines of A would be obliterated under the conditions holding in case 2, but in all cases the increase in the brilliancy of the lines of B would be large compared with the increase of those in A.

We see from the equations giving E_1 and E_2 that until the supply of energy has lasted for a time comparable with $1/\beta_2$, E_2 is large compared with E_1; thus for electrical discharges which last for an exceedingly short time we

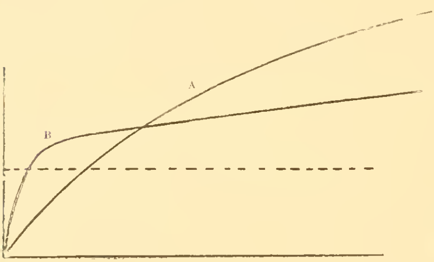


FIG. 5

might easily have the lines of B visible and not those of A.

In a discharge tube conveying an electrical current the amount of work per unit volume of the gas done by the electrical forces per unit time varies very largely from one point of the tube to another; if the cross section of the discharge is the same at all parts of the tube, so that the current density is uniform, the rate at which the electrical forces do work will be proportional to the electric force; as this is much greater near the kathode than at other parts of the tube, we should expect the lines of systems of the type B to preponderate near the kathode, and to be absent or much feebler in other parts of the tube. If the tube were of the type frequently used for spectroscopic purposes with a capillary portion in the middle, then since the current density is much greater in this portion than in any other, the rate of work per unit volume of the gas will be much greater in the capillary portions than in the wide parts of the tube, and we should therefore expect the lines of systems of the type B to be much more prominent in the capillary part than in the wide part.

Effect of Self-induction and Capacity.—Suppose that we have a tube of uniform bore arranged as in Fig. 6, the terminal of the tube being connected with the plates of a condenser of capacity C, and that there is a coil the coefficient of self-induction of which is L placed in series with the tube; then if the discharge through the coil begins when the potential difference between the plates of the condenser is V_0, the potential difference between the plates after a time t will be

$$V_0 \cos pt,$$

and the current through the tube

$$CV_0 p \sin pt,$$

where $p = 1/\sqrt{LC}$.

Thus the maximum value of the product of the current and the potential difference, *i.e.* rate at which the electric forces are doing work in the tube, is $CV_0^2 p$ or $V_0^2\sqrt{C/L}$, and is thus proportional to the square root of the capacity and inversely proportional to the square root of the self-induction. Thus increasing the capacity increases the maximum rate of work, and therefore increases the brilliancy of the lines corresponding to systems of the type B relatively to those of type A, while inserting self-induction in the circuit increases the brilliancy of those of type A as compared with those of type B. If we suppose that the "blue" spectrum of argon corresponds to a system of type B, the red to a system of type A, we have an explanation of the changes in the spectrum of this gas, for by inserting capacity in the circuit we can change from the red to the blue spectrum, while having got the blue we can get back to the red by inserting self-induction. I have here a little model which is intended to illustrate the way in which the red and blue spectra of argon originate. It is based on the fact that when we send a current of electricity through a circuit the current

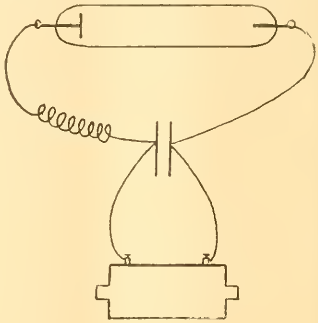


FIG. 6.

does not rise to its steady value instantaneously, but, starting from zero, increases with the time in exactly the same way as we have supposed the intrinsic energy in the atom, *i.e.* the way represented by the curve in Fig. 4. The quantity in the electrical case corresponding to the radiation β is the resistance of the circuit divided by the self-induction, while the quantity α is inversely proportional to the self-induction. Thus a circuit with large self-induction and small resistance is analogous to the system A, while one with small self-induction and large resistance is analogous to a system of type B. Now my model of the argon atom consists of two circuits, C and D, placed in parallel. C has large self-induction and small resistance, D has little self-induction but large resistance. An electric lamp is placed in each circuit. If I supply energy in one way, *i.e.* by continuous current, to the system, the red lamp in C lights up, the blue lamp in D is dark, while if fed by an alternating current the blue lamp shines and the red is dark. It would be interesting to see whether as we gradually diminish the self-induction we get the whole of the lines in the blue spectrum at once, or whether the lines of this spectrum enter in groups one after the other. I have tried somewhat similar experiments with the hot lime kathode to see in a mixture of gases, mercury vapour and air, which spectrum first appeared as the rate of doing work in the gas was gradually increased. The great difficulty in this determination is that when once

the luminosity begins there is such a rapid increase in the ionisation that the current through the gas and the rate of doing work increase in an exceedingly short time through a wide range of values, and thus a gradual increase in the rate of work is exceedingly difficult to obtain. On several occasions, however, I was convinced that on gradually increasing the rate of work the mercury lines were the first to appear, and were the last to disappear when the rate of work was reduced from a high value, at which both the nitrogen and mercury spectra were bright, down to a point where the discharge ceased to be luminous.

The preceding considerations have also an important application to the difference between the arc and spark spectra. In the continuous arc discharge, although the average rate of work is much higher than in the spark, the maximum rate is very much less; in the spark discharge we have an exceedingly intense current density lasting for a very short time, and while the spark is passing we have a very much greater rate of work than in the arc. Hence the state of things in the spark will be analogous to that represented in Fig. 5, and the lines corresponding to systems of the type B will be enhanced relatively to those of type A; we conclude, then, that the arc lines correspond to systems of the type A, the spark lines to those of type B.

The work done in the discharge tube is probably ultimately converted for the most part into heat, so that the rate at which work is being done at any part of the tube is approximately proportional to the rate at which heat is being produced in the tube. I do not, however, regard temperature, *i.e.* the energy due to the translation of the atoms as a whole, as having any direct connection with the production of spectra. The work done by the electric field on the corpuscles is, since the corpuscles can easily penetrate the atoms of the gas, first converted into internal atomic energy; this energy may ultimately be for the most part transformed into the energy of translation of the molecules of the gas, and so appear as temperature, but it by no means follows that if we heat the molecules of the gas by non-electrical means to the temperature to which even a few of its molecules are raised by the electric discharge we shall get a luminous spectrum. The production of the spectrum depends upon the internal energy of the atom; when we use the electric discharge all the work done by the corpuscles goes at first into the form of internal atomic energy, while if we supply the same amount of energy to the gas by thermal, as distinguished from electrical, means, the energy will go first into increasing the energy of translation of the atom, and very little of it will ever get inside the atom. It is probable, however, that some of the energy of translation will get converted into internal energy, and that temperature is one way of giving internal energy to the atom, and so producing luminosity; from our point of view, however, it is a very extravagant method, as the fraction of the energy spent in heating the gas which goes to produce luminosity is small.

The coefficient of absorption α of the systems will depend upon the way in which the internal energy is given to the atom as well as upon the rate at which the electric field is doing work in the neighbourhood of the atom. Thus, for example, if the internal work is given by means of rapidly moving corpuscles, the coefficient of absorption will depend upon the velocity of the corpuscle, for we can easily show that when a corpuscle passes at a fixed distance from a system of corpuscles having a definite period of vibration there is one velocity of the corpuscle, depending on this period, fast if the period is short, slow if it is long, for which the energy given by the corpuscle to the system is a maximum. Thus the relation between the amounts of energy absorbed by two systems from the corpuscles depends upon the velocity of the corpuscles. The velocity of the corpuscles in a discharge tube depends upon the pressure of the gas, so that even though the rate at which the electrical forces are doing work may be the same at two different pressures, the relative intensities of the lines of two systems A and B may be different.

Again, we might expect that the coefficient of the rate of absorption of energy would be different according as the energy is given to the atom by means of the large systems which form the positive ions or by means of small corpuscles, and that the relative brightness of lines might be different in the two cases. In the Kanal-strahlen we have positive ions moving through a gas and producing luminosity, and the spectrum of this luminosity possesses interesting peculiarities differentiating it from the spectrum of other parts of the tube. Perhaps the most striking difference, however, is when the positive ions strike against a salt like lithium chloride; they make the red lithium line appear with great brilliancy, while if corpuscles strike against the chloride the red line is not visible. It is remarkable that the spectrum of the metal is produced much more readily by the positive ions when they strike against a salt of the metal than when they strike against the metal itself; this is shown in a striking way if we take the liquid alloy of sodium and potassium and direct a stream of Kanal-strahlen upon it; the clean parts of the alloy appear quite dark, but the specks of oxide scattered over its surface shine with a bright yellow light, giving the sodium spectrum.

When the internal energy of the atom is increased by means of light, as in Prof. Wood's beautiful experiments on the fluorescence of sodium vapour, the coefficient of absorption of a system will depend upon the relations between the periods of that system and the period of the incident light vibrations; thus, as Prof. Wood found to be the case, the numerous lines in the spectrum given out by the vapour alter greatly in character and wave-length when the period of the incident light is changed.

The same principles which explain the variation in the intensities of the spectra given out by two different systems in the same atom can be applied to explain the variations in the intensities of the spectra of two gases, A and B, when these are mixed together. We know that under some conditions the lines of only one constituent of the mixture appear, while under others we get the lines of both the gases. Let us suppose that the lines of A appear with a lower rate of work of the electric forces than those of B, and that we send a constant current through the discharge tube, we can calculate what the electric force must be to produce from the molecules of A alone the number of ions required to carry this current; having found the electric force on this supposition, we can, knowing the current, find the rate at which the electric forces would be doing work in the tube; if this rate of work is less than that required to make B luminous, the current will be carried by the ions of A alone, and the spectrum of B will not be developed; if the rate of work on this supposition is greater than that required to make B luminous, the spectrum of B will appear, and it must take a share in carrying the current. Let us suppose that we have so much of A present that the rate of work is not sufficient to develop the spectrum of B, and consider what will happen as the proportion of A is diminished. In order to supply the number of ions required to carry the given current from the smaller number of molecules of A, the electric force, and therefore the rate of work in the tube, must, on the supposition that the current is wholly carried by A, increase, and if we continually diminish the amount of A present the rate of work will at last reach a value sufficient to make B luminous with the given current. This stage will give the smallest quantity of A which can for the given current wholly swamp the spectrum of B. The rate of work done in the tube will depend on the current going through it and also on the pressure of the gases, so that both these quantities will influence the proportion of the gas B required to make its spectrum visible.

MICROSCOPIC AQUATIC PLANTS AND THEIR PLACE IN NATURE.[1]

EVERY piece of water, besides containing large plants and animals which are readily visible to the naked eye, harbours a more or less considerable number of minute forms, which pervade all the layers of the water in varying amount, and collectively constitute the plankton or pelagic life. The most important difference between the

[1] Abstract of a lecture on "The Microscopic Plants of our Waters," delivered before the London Institution on February 1 by Dr. F. E. Fritsch.

plankton and the remaining flora and fauna of our waters lies in the fact that all the organisms which compose it are free-floating during the greater part of their life. Practically all the pelagic plants belong to the group of the algæ, and their minute size, of course, suits them well to a floating existence. A certain number of them are motile (*e.g.* Volvox, Gonium, Pandorina, &c.), and these are able actively to maintain themselves in their position in the water; but the large majority are non-motile, and all these forms are slightly heavier than water, and consequently tend to sink; they develop diverse mechanisms, by means of which their power of flotation is increased. The most important of these are:—assumption of a flat plate-like shape (Pediastrum, Merismopedia, many Desmids); development of numerous delicate processes from the body of the plant (Stephanodiscus, Richteriella); arrangement of the individuals of a colony in a more or less stellate manner (Asterionella, some Tabellarias); assumption of a delicate acicular shape (Synedra); formation of fat in the cell (many Diatoms and Cyanophyceæ), and so on.

In spite of these adaptations, however, most of the non-motile organisms of the plankton sink to the bottom of the containing vessel in the space of a few minutes after they have been collected. How is it that this does not happen in nature? It has been suggested that the continuous currents in the water, due to the wind and other causes, help to buoy up the organisms of the plankton; but it is of course also possible that in collecting such delicate forms they are damaged in some way or other so as to deprive them of that power of floating which suits them so well to their natural habitat. An interesting point connected with the development of the diverse floating mechanisms is that in some plants they have been found to be far more strongly developed in the summer than in the winter forms; this is, undoubtedly, in some way connected with the lower specific gravity of the water in summer, although the exact relation is not yet quite evident.

If the plankton of any piece of water is examined from week to week or month to month, we find not only astonishing variations in the quantity of organisms present, but also very marked differences in the specific constitution of the pelagic life. The quantity of the plankton is generally very much less in the winter than in the summer months, and the organisms composing it are quite different in the two seasons. Thus in the Thames there are four well marked annual phases, each characterised by its own peculiar plankton. This periodicity exhibited by the pelagic life stands in close relation to the external seasonal changes; some of the forms prefer cold, others warm water, and consequently they flourish in those seasons which are most to their liking. Some plants are particularly sensitive, and consequently only put in an appearance for a very short space of time each year. During their period of absence from the plankton these organisms persist as resting spores in the mud at the bottom of the piece of water; when favourable conditions return the spores germinate, giving rise to a new generation of pelagic organisms, which by their prolific division are able to dominate completely a piece of water in a few days' time.

The pelagic plants form the food of the animal plankton; these, again, are devoured by their larger brethren, which are the main source of nutrition for the smaller fishes. The larger fish are mostly carnivorous, feeding on smaller individuals of their kind. The organic matter of the pelagic plants thus gradually travels from one organism to another until it comes to form part of the body of the large aquatic animals; it passes through a series of incarnations before being returned to the water in the form of excrements or products of decay of dead animal and vegetable bodies. This organic matter is built up by the pelagic plants from simple inorganic salts and from carbon dioxide dissolved in the water, and these latter substances are thus changed into a form which makes them available to the aquatic fauna. All the organisms of the latter, as, indeed, all the animals of the world, are ultimately herbivorous. Without some kind of plant growth a piece of water must remain a lifeless, dead mass, unpopulated, and a thing apart from the living world around it. The presence of vegetation immediately transforms it into a throbbing universe, full of energetic life, exhibiting complex inter-relationships, and connects it with the remaining parts of our universe. The most important element of the vegetation from this point of view, however, is the phytoplankton, and a piece of water with plenty of pelagic plants is sure to form a good breeding-place for fish and other aquatic animals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The report of the committee of the school of geography for 1905 shows that the school now holds a strong position in the University, and is doing valuable work in encouraging the study of geography and surveying, and in providing special courses of geographical lectures suited to the requirements of the different final honour schools. Both the lectures and practical instruction were well attended throughout the year, although there were only a few candidates for the diploma. This year, in addition to the ordinary work during term, a special course lasting three weeks, specially suited to those who are engaged in teaching, is being arranged for August. The instruction will be both practical and theoretical, and there ought to be no lack of support for so useful an innovation.

Cambridge.—The forestry committee having been commissioned to submit a scheme of study and examination for the diploma in forestry, recommends that the Senate approve the following:—Candidates, before receiving the diploma in forestry, shall be required to produce evidence that they have (1) passed (or obtained exemption from) the Previous examination, together with the additional subjects; (2) satisfied the examiners in physics, chemistry, geology, and botany, either in part i. of the examination for the diploma in agriculture, or in that examination in combination with the Natural Sciences Tripos, part i., or in some other examination or examinations approved by the committee; (3) diligently attended courses of instruction in forest botany, in entomology, in forestry, in forest mensuration, surveying, and engineering, and such other courses in related subjects as may from time to time be approved by the committee; (4) attended for a time equivalent to one academical year courses of instruction in practical forestry approved by the committee; (5) obtained a certificate of proficiency in practical forestry approved by the committee; (6) passed the examination for the diploma; (7) been admitted to a degree in the University.

The general board of studies has approved for the degree of Doctor in Science Mr. G. H. F. Nuttall, Christ's College.

The general board of studies also recommends that it be authorised to appoint, subject to confirmation by the special board for medicine, Mr. G. H. F. Nuttall to be reader in hygiene in connection with the special board for medicine; that the university lectureship in bacteriology and preventive medicine terminate on his appointment as reader; and that the readership terminate with the tenure of office of Mr. Nuttall.

Dr. W. A. Thornton has been appointed to the newly-created professorship of electrical engineering at Armstrong College, Newcastle.

According to a message from Wolfville, Nova Scotia, Mr. Carnegie has promised to the Acadia University 6000*l.* for a new science building as soon as 20,000*l.* has been raised for a forward movement now in progress. Of this sum nearly half is already in hand, and the rest is definitely promised.

The council and principal of the Bedford College for Women will hold the usual reception at the college on Commemoration Day, May 9, after the presentations for degrees at the University of London. The Pfeiffer entrance scholarship in science, tenable for three years, and of the annual value of 48*l.*, will be offered for competition in June next.

At the annual dinner of the students of the Camborne Mining School, held in Camborne on March 10, the prin-

cipal, Mr. J. J. Beringer, in reviewing the growth of the school for the past ten years, made some remarks upon the recent report of the departmental committee on the Royal College of Science. He pointed out that while the fellows of the faculty of mining and metallurgy may be only capable of being produced and fully nourished to maturity in the new institution, yet the general practitioners would still find their way to Camborne for their training. The chairman of the school committee, Mr. C. V. Thomas, remarked that though encouragement was given by the Government and the County Council, sufficient material assistance had always been wanting, and plans for extensions were crippled for want of funds.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"A Biometrical Study of Conjugation in Paramæcium." By Dr. Raymond **Pearl**. Communicated by Prof. Karl Pearson, F.R.S.

The purpose of this investigation was to determine whether any sensible differentiation exists between the conjugating and non-conjugating members of a population of the common ciliate infusorian *Paramaecium caudatum*, and to what degree structurally similar individuals tend to pair together in conjugation. The characters principally studied were length and greatest breadth of the body, and the shape of the organism as measured by the length-breadth index. The material used covered a considerable range of cultural conditions. It was found that there is a very considerable differentiation between conjugant and non-conjugant individuals. In respect to the absolute size characters (length and breadth of body), the differences between the means for the two groups of individuals amounted to from 10 per cent. to 20 per cent. of the mean size of the larger (non-conjugant) individuals. Not only are conjugants absolutely smaller than non-conjugants, but they are also sensibly differentiated in shape. Further, they are much less variable, and less highly correlated. There is a strongly marked tendency for like to pair with like in the conjugation of Paramæcium. The coefficients of correlation measuring homogamy in conjugation, are relatively very high, both for direct and cross assortative pairing, in all the characters examined. By an experimental study of random pairings it was shown that this homogamy in conjugation is due to a real assorting and pairing of like with like, and not a spurious effect of local differentiation in the culture. Further, by comparing records obtained from recently united pairs of conjugants with similar records from pairs about to separate, it was shown that the results cannot be due to any process of equalisation in size during the process of conjugation itself. The probable manner in which the homogamic pairing is brought about is discussed, and it is shown that the results are easily explicable on the basis of known facts regarding the behaviour of the organism. It is pointed out that the demonstration of the existence of a relatively fixed "conjugant type" has a direct bearing on current views as to the theoretical significance of protozoan methods of reproduction. The importance of getting positive evidence that a sensible degree of homogamy actually exists among organisms living under natural conditions has been many times emphasised by writers on evolution. The present work brings forward such evidence for a single organism standing low in the scale of organisation.

January 18.—"A Case of Regeneration in Polychæte Worms." By Arnold T. **Watson**. Communicated by Prof. C. S. Sherrington, F.R.S.

January 25.—"On the Overstraining of Iron by Tension and Compression." By Dr. James **Muir**. Communicated by Prof. A. Gray, F.R.S.

The behaviour of mild steel under compression is investigated. Compression stress-strain curves are usually shown very much rounded at the yield-point. In this paper a specimen of steel is shown to have obeyed Hooke's law until abrupt permanent shortening occurred at the stress of 21½ tons per square inch. At this stress the reading on a Ewing "compression extensometer" altered from 241 to 2900 without increase of load. This permanent shortening at the compression yield-point was found to be practically equal to the extension at the tension yield-point of the same material. A second compression test made on the same specimen, after recovery from the compressional overstrain, showed that the compression yield-point had been raised by a step of 4 tons per square inch. This was approximately the step by which the tension yield-point of the material could be raised by tensile overstrain.

Experiments were further made to investigate the behaviour under compression of steel which had previously been subjected to tensile overstrain. The experiments seem to indicate that there are two distinct causes contributing to the phenomenon of hardening by tensile overstrain:—(1) the overstraining itself—the actual stretching of the material—seems to harden the material equally as regards both resistance to tension and to compression; while (2) the process of recovery from tensile overstrain, which seems to bring into existence an internal stress, raises the tension yield-point by a definite step above the overstraining stress, but seems to lower the compression yield-point by approximately an equal amount below the overstraining stress. For example, a specimen subjected to a series of tension tests in which the loading is carried just beyond the yield-point (recovery from overstrain being effected between each test) might exhibit yield-points at 20, 25, 30, 35, and 40 tons per square inch. The corresponding compression yield-points should probably occur at about 20, 15, 20, 25, and 30 tons per square inch. This conjecture can scarcely be said to have been fully established, further research being necessary; but it is shown that steel may be hardened by tensile overstrain to resist higher stresses both in tension and in compression, although material so hardened always withstands a greater stress in tension than in compression.

February 8.—"Polarisation in Secondary Röntgen Radiation." By Dr. C. G. **Barkla**. Communicated by Prof. J. J. Thomson, F.R.S.

In a previous paper the author gave an account of experiments which demonstrated the partial polarisation of a beam of X-rays proceeding from the anti-kathode of an X-ray focus tube. The secondary radiation from substances of low atomic weight placed in the primary beam, however, varied in intensity in the two principal directions by not more than about 20 per cent.

The experiments described in this paper were made on the secondary radiation proceeding from a substance of low atomic weight, for, according to the theory given, the radiation proceeding in a direction perpendicular to that of propagation of the primary should be almost completely polarised.

The method was similar to that used in previous experiments, the intensity of tertiary radiation from a light substance placed in the secondary beam being studied by means of electroscopes, shielded from the direct primary and secondary radiations.

The principal experimental difficulties were due to the weakness of the tertiary beams.

Carbon was chosen as the radiating substance because the energy of secondary radiation from substances of low atomic weight had been found to be proportional merely to the quantity of matter passed through by a primary of given intensity, and as absorption diminishes with the atomic weight, the lower the atomic weight the greater is the energy of secondary radiation proceeding from thick plates exposed to a given primary.

A large mass of carbon was placed in the primary beam, and the horizontal secondary beam proceeding from this in a direction perpendicular to that of propagation of the primary was studied. In it was placed a second mass of carbon, and two electroscopes were situated to receive tertiary rays proceeding in horizontal and vertical directions. As the X-ray tube was turned round the axis of the secondary beam, the intensities of tertiary radiation in the two directions changed, one increasing to a maximum while the other decreased to a minimum.

It was found that the horizontal tertiary reached a maximum and the vertical a minimum when the primary beam was horizontal, and that the conditions were reversed when the primary was turned through a right-angle.

This result was anticipated by the theory previously given, and may be explained by considering the electrons in the radiating substance to be accelerated in the direction of electric displacement in the pulses passing over them.

The intensities in the two principal directions were approximately in the ratio 3 : 1. Considering the obliquity of primary, secondary, and tertiary rays in the beams experimented upon, this result indicates fairly complete polarisation in a narrow pencil of secondary radiation proceeding from the substance in a direction perpendicular to that of propagation of the primary.

When iron was used as the radiator in the secondary beam, though the rates of deflection of the electroscopes were of the same order of magnitude as before, there was no appreciable variation as the direction of the primary beam was changed.

This result was what previous experiments on iron led one to expect, and was the most conclusive proof of the interpretation of the results obtained with carbon. The independence of motion of the electrons disappears in the heavier atoms, and each is subject to considerable forces not directly due to the primary pulse (in this case the secondary pulse) and not in the direction of electric displacement in this pulse. Hence the variation in intensity of the tertiary in different directions becomes inappreciable, while the pulse thickness in the tertiary beam becomes greater than in the secondary, and is consequently more readily absorbed.

Geological Society, February 16.—Annual General meeting. Dr. J. E. Marr, F.R.S., president, in the chair.—Influence of the geological structure of English Lakeland upon its present features. Anniversary address: **President.** After an account of the light thrown upon the structure of Lakeland by the writings of other geologists, the president considered his subject under the following heads:—Events prior to the uplift which produced the dome; production of the dome; initiation of the drainage-lines; effects of the three types of rocks upon the scenery; modification of old drainage-lines; depression of the outskirts; effects of meteorological conditions, (1) general, (2) the Glacial period. Of the events prior to the dome-shaped uplift, he laid greatest stress upon the movements of Devonian times, which had caused the Lower Palæozoic rocks to be affected by fractures forming a roughly rhomboidal network, the fissures being marked by belts of broken rock along their courses. He accepted Hopkins's view of the formation of a dome comparable in shape to a "caddy-spoon" with the short handle to the east. He gave further reasons in support of the view that the uplift of the dome and the final movements of the Pennine Chain were of Tertiary date. After commenting on the theory that rocks of New Red Sandstone age extended over the district, he discussed the nature of the radial drainage impressed upon these newer rocks during the uplift of the dome, and the removal of these rocks in the district itself by denudation, producing a superimposed drainage on the Lower Palæozoic rocks. The changes which took place in the valleys as the result of the imposition of the rivers upon the ancient rocks were then discussed, and it was maintained that diversion of the river-courses had largely taken place owing to the easier erosion along the shatter-belts. When discussing the effects of meteorological conditions he commented on hill-outlines, where the upper parts of hill-slopes presented a convex outline towards west and south, and a concave curve towards east and north. This he attempted to explain as due to the more profuse growth of vegetation on the slopes facing west and south.

February 21.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The constitution of the interior of the earth, as revealed by earthquakes: R. D. **Oldham.** This paper sets forth the information to be obtained from the records of distant earthquakes. The record of a great earthquake exhibits three phases, of which the third represents wave-motion travelling along the surface of the earth, and can give no information regarding the interior. The other two phases form the preliminary tremors, and represent the emergence of two forms of wave-motion propagated through the earth. Up to a distance of 120° of arc from the origin, these waves are propagated at a rate which increases with the depth of the wave-path, and reaches an average of more than 10 km. sec. for the first-phase, and more than 6 km. sec. for the second-phase waves. The increase may be attributed to the effect of increased pressure and temperature. Beyond this limit the first-phase waves show a reduction in the mean rate of transmission, while the second-phase waves are found, not where they would be expected, but at about 11′ later. Two interpretations are given. Either alternative leads to the conclusion that, after the outermost crust of the earth is passed, there is no indication of any rapid change of physical and chemical properties until a depth of about six-tenths of the radius is reached.—The Tarannon series of Tarannon: Dr. Ethel M. R. **Wood.** The Tarannon strata are well developed in the Llanbrynmair-Tarannon district, and the present paper gives the results of a detailed survey of the entire Tarannon series as there exhibited. Lists of the contained graptolites are given, and the species are paralleled with those from the corresponding beds of the south of Scotland, the Lake District, North Wales, central Wales, and Sweden, demonstrating the similarity of the graptolitic succession in all these districts. The Tarannon series in this district has a maximum thickness of 3500 feet, but thins somewhat as it is traced north-westward. It rests conformably on Llandovery rocks below, and passes up without a break into Wenlock beds above. This rock-series is stratigraphically continuous from base to summit. The strata of the overlying Wenlock series present all the characters of the Denbigh Grits and Flags of North Wales. The Llandovery series, which underlies the Tarannon series, has, at present, been recognised only in the western part of the district, namely, in the valley of the Twymyn, and its rocks are brought to the surface by an anticlinal fold. A comparison of the graptolitic lists shows that the Tarannon series, as here defined, corresponds almost exactly with the Gala or Queensberry group of the south of Scotland, includes all the palæontological zones hitherto assigned to the Tarannon, and fills up the whole period intervening between the Llandovery below and the Wenlock above.

Physical Society, February 23.—Prof. J. Perry, F.R.S., president, in the chair.—A note on Talbot's lines: J. **Walker.** The diffraction-pattern of a line of monochromatic light seen in focus, due to a rectangular aperture with its sides parallel to the line, is characterised by dark bands arranged at equal intervals on either side of the geometrical image of the line. The effect of covering half the aperture with a retarding plate is to displace the bands of an odd order towards the covered side by an amount proportional to the retardation introduced, those of an even order remaining fixed. Suppose that the light is white and that its monochromatic constituents have been made by spectral analysis to occupy different angular positions in the field. Owing to the dispersion, the bands of an even order are obliterated; but in the case of those of an odd order the dispersing power of the plate itself produces a dispersion of the bands, and consequently these bands will be seen, provided the plate have a suitable thickness and be so placed that the dispersion of the bands produced by it acts in opposition to the primitive dispersion of the light.—Secondary Röntgen radiation: Dr. C. G. **Barkla.** In previous papers the author has shown that the secondary X-rays from certain gases and light solids subject to Röntgen radiation may be fully explained by considering the corpuscles or electrons constituting the atoms to be accelerated in the direction of electric displacement in each primary Röntgen pulse as it passes through such substances, and that the interaction between the electrons affects only to a slight extent the character of the secondary radiation. Experiments on the absorption of rays proceeding from thick plates of a large number of elements showed that beyond the region of atomic weights in which the character of the secondary radiation is almost independent of the nature of the radiation, the absorbability is a periodic function of the atomic weight of the radiator, and that, so far as these experiments have gone, different periods are represented by curves of similar form. The theory which has been found to explain all the pheno-

mena of secondary radiation from light atoms may be extended to explain these results, if the independence of motion of the electrons is conceived to disappear with an increase in the number of electrons in the atom.—Records of the difference of potential between railway lines when a train passes and at other times, and a suggested method for the observation of earth currents and magnetic variations: C. W. S. **Crawley** and F. B. O. **Hawes.** The experiments described in the paper were made on the London and South-Western main line, between Walton and Weybridge stations. To each rail of the up line a wire was permanently attached, and the other ends of the wires were connected to the terminals of a reflecting galvanometer. The deflections of the galvanometer were recorded on a moving sheet of paper, and curves obtained showing the variation in the current through the galvanometer. The curves showed a concordance in the results from successive trains. The normal current through the galvanometer began to be disturbed about one minute before the passage of a train, and the disturbance lasted about two minutes.

Royal Microscopical Society, February 21.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—A method of producing stereo-photomicrographs: W. P. **Dollman.** A number of good stereoscopic prints were exhibited in the room in illustration of the paper.—A simple method of taking stereo-photomicrographs and of mounting the prints without cutting: Mr. **Taverner.** Though this paper was upon the same subject as the previous one, the methods of the authors were different, and Mr. Dollman limits his operations to very low powers, giving amplifications of 9 to 20 diameters only. He uses a stop in front of the objective, and exposes first one side of the lens and then the other as he takes his two stereoscopic pictures. Mr. Taverner uses higher powers, and a peculiar stop at the back of the objective. The authors adopt a similar arrangement for obviating the necessity of cutting the prints.—A second list of rotifers of Natal: Hon. T. **Kirkman.** The author described a remarkable new species, *Copeus triangulatus*.

Anthropological Institute, February 27.—Prof W. Gowland, president, in the chair.—Ancestor worship in Japan: W. G. **Aston.** It was shown that the so-called ancestor worship of the Japanese is in reality a cult of the sun and other nature deities, but as the sun or sun-goddess, by a genealogy which covers a period of about 2,000,000 years and contains many miraculous incidents, is feigned to be the ancestor of the Mikados, the Japanese naturally speak of this cult as ancestor worship. We should not follow their example. The descent of the Japanese nobility from the sun-goddess and other deities of the old Pantheon is to be regarded in the same light. There is a worship of true ancestors in Japan, but it is due to Chinese influence, and is of later origin.—Anthropological notes from Lake Tanganyika: W. A. **Cunnington.** The author dealt with the manners, customs, and arts, &c., of the natives living by the lake. Among the slides exhibited was a series showing the different stages of the manufacture of a pot, the peculiar point being that the bottom of the pot is put in last. Other slides showed examples of weapons, dress, houses, and costumes of the natives.

March 13.—Prof. W. Gowland in the chair.—A collection of Palæolithic implements from the neighbourhood of Southampton: W. **Dale.** The author divided the implements into the following groups:—flakes, plain and trimmed; implements with the butt end purposely left smooth, used for chopping; oval- and almond-shaped implements with a cutting edge all round; pointed implements with both edges equal, and tapering gradually; pointed implements with one curved and one straight edge, adapted for making long cutting strokes; pointed implements in which one side has been left as flat as possible—these occur very sparingly in the Hants gravels.—Materials for a study of tatu in Borneo: R. **Shelford** and Dr. C. **Hose.** The paper contained the observations made by the writers amongst the Kayans, Kenyahs, Bakatans, Kalabits, and Sea-Dayaks of Sarawak. All the information on the subject by previous writers had been analysed and compared, special use being made of Dr. A. Nieuwenhuis's books on Borneo. Kayan tatu, which is still a flourishing art, was described in considerable detail, not only with reference to the tatu designs employed, but also to the elaborate ceremonial accompanying the practice. The Kenyahs and Sea-Dayaks also appear to have borrowed the practice of tatu very largely from the Kayans; but most of the Indonesian tribes have all had at one time or another a distinctive tatu. It is most unfortunate that the practice is rapidly dying out amongst these people. It was not found possible to classify the tatued peoples of Borneo in three main divisions as had been done by Dr. Nieuwenhuis for those of a less extended area.

Linnean Society, March 1.—Prof. W. A. Herdman, F R.S., president, in the chair.—A new type of stem from the Coal-measures: Dr. D. H. **Scott.** The stem is one of the many interesting fossils obtained from the pit at Shore-Littleborough, in Lancashire, opened up for scientific purposes by the generosity of the owner, Mr. W. H. Sutcliffe. The sections were cut by Mr. J. Lomax. The specimen was derived from one of the roof-nodules, which generally represent a peculiar flora, distinct from that of the seam-nodules immediately below. Specimens of the great petioles of the same plant had been discovered a year or two before the stem itself came to light. The fragment was about 15 cm. long, and belonged to a stem of considerable size, the diameter being about $12 \times 6 \cdot 5$ cm. The new stem is referred to the family Medulloseæ, of which it constitutes a unique type. It is placed in a new genus, named Sutcliffia, in honour of Mr. Sutcliffe, of Shore-Littleborough, and the specific name *S. insignis* is proposed for it.—Notes on some species of Nereis in the district of the Thames estuary: Dr. H. C. **Sorby.** In the course of yachting expeditions during successive summers for more than twenty years, Dr. Sorby has observed some remarkable facts connected with the Heteronereis form in two species of Nereis. The rarity of the occurrences should make the record of them acceptable. Notes are given in the paper on five species of Nereis found in the Thames district.

Sociological Society, March 14.—Prof. E. Ray Lankester, F.R.S., in the chair.—Notes on the sociological appeal to biology for suggestion: Prof. J. A. **Thomson.** The sociologist is beginning to recognise the usefulness of analysing out the organic processes which contribute to the result which we call social activity. The same is true of the sociologist's appeal to biology. If the recognition of biological factors operative in social activity is very partial the result is sure to be fallacious. By recognising the operation of biological factors in the life of a societary group the sociologist brings what is distinctively social into greater prominence. There is some danger of an inaccurate "materialism" if we pretend that sociology is merely a higher department of biology. The chief value of the appeal to biology by sociological students is threefold:—(*a*) aiding in analysis; (*b*) showing that various modes of social activity have a biological aspect; (*c*) suggesting from biological experience the discovery of sociological laws.

PARIS.

Academy of Sciences, March 12.—M. H. Poincaré in the chair.—The propagation of a movement round a centre in an elastic, homogeneous, and isotropic medium: J. **Boussinesq.**—The effects of the absorption of tuberculin by the digestive tube in healthy and tuberculous animals: A. **Calmette** and M. **Breton.** The experiments described show that tuberculin, when absorbed by the alimentary canal, is toxic for non-tuberculous animals, the effect being especially marked for young animals. The tuberculin is no better tolerated when the dosage starts from a minimum and is progressively increased. For tuberculous animals a very much smaller dose of tuberculin is poisonous.—The evolution of the Tertiary mammals: the importance of migrations: Charles **Depéret.**—The seventh scientific voyage of the *Princess Alice*: **Prince Albert of Monaco.** General description of the work done in oceanography, zoology, microbiology, and meteorology of the Sargasso Sea, in mid-Atlantic.—Observations of the comet 1906*b*

made with the large equatorial of the Observatory of Bordeaux: E. **Esclangon.** The observations were made on March 6 and 7. The comet had the appearance of a star of 10·5 magnitude, surrounded by a very feeble luminosity.—The electromotive forces of contact between metals and liquids, and an improvement in the ionograph: Charles **Nordmann.** Diagrams are given of the apparatus and of a record of the recording instrument for a period of twelve hours.—The sympathetic vibration of a string giving a low note under the influence of one giving a higher note, and the possible consequences arising from this: Edmond **Bailly.** It has been held up to now that a note cannot produce a sympathetic vibration in a string of lower pitch than itself. The author describes an experiment leading to a contrary conclusion.—The action of hot sulphuric acid on salts of platinum and iridium in the presence of sulphate of ammonium: Marcel **Delépine.** Both these metals are dissolved by boiling sulphuric acid in very appreciable quantities. Complex acids appear to be formed in which the sulphuric acid is not precipitable by barium chloride.—The action of peroxide of nitrogen on ammonia and some ammoniacal salts: MM. **Besson** and **Rosset.** When liquid ammonia at −90° C. is added to solid nitrogen peroxide at the same temperature there is a violent explosion. The reaction can be moderated by working with ammonia gas at −20° C.; the products are nitrogen, nitric oxide, and ammonium nitrate.—The action of silicon chloride upon cobalt: Em. **Vigouroux.** At a high temperature silicon chloride is reduced by cobalt, a volatile metallic chloride being formed and a cobaltosilicon remaining behind. The amount of silicon in this latter compound tends to the silicide Co_2Si as a limit.—The dilactide of lævorotatory lactic acid: E. **Jungfleisch** and M. **Godchot.**—A method of determination of the foreign materials contained in cocoa and chocolate: F. **Bordas** and M. **Touplain.** The substance is treated with carbon tetrachloride mixed with varying proportions of benzene, so as to get a range of density between 1·6 and 1·346. A separation of the materials of different densities is readily effected.—Polyvalent antioxydase serum: C. **Gessar.**—Contribution to the systematic anatomy of some kinds of ferns: Ferdinand **Pelourde.**—Nuclear fertilisation in the Mucorineæ: M. **Dangeard.**—*Hylochoerus Meinertzhageni*: Maurice **de Rothschild** and Henri **Neuville.**—The structure of the cæcum or filiform appendices of the middle intestine of *Phyllium crurifolium*: L. **Bordas.**—The comparative anatomy of the Sipunculidæ: Marcel A. **Hérubel.**—The evolution of the supposed coccidia of cephalopods: Th. **Moroff.**—A new disease of the trout: L. **Léger.**—The analysis of tubercle bacilli: G. **Baudran.** Separate analyses were made of dead and living bacilli. The former gave lecithin, cholesterin, and fat, cellulose, nuclein, and albumenoid materials. The living bacilli gave, in addition, an anaëroxydase and an alkaloid.—The reaction of the blood a function of nutrition: Jean **Gautrelet.** There is an absolute parallelism between the apparent alkalinity of the blood and the activity of the organic exchanges as measured by the amount of hæmoglobin.—The Pleistocene glaciers in the valleys of Andorre: Marcel **Chevalier.**—The volcanoes of the Livradois and Comté, Puy-de-Dôme: Ph. **Glangeaud.**—The tectonic of the Ivrée and Strona zones: Émile **Argand.**—The diatom-bearing sediments of the region of Lake Tchad: Paul **Petit** and H. **Courtet.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: Recent Advances in Seismology; Prof. J. Milne, F.R.S.—On Methods whereby the Radiation of Electric Waves may be mainly confined to Certain Directions, and whereby the Receptivity of a Receiver may be restricted to Electric Waves emanating from Certain Directions: Chevalier G. Marconi.—A Note on the Theory of Directive Antennæ or Unsymmetrical Hertzian Oscillators: Prof J. A. Fleming, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 9.—Imperial Defence: Lord Roberts.

PHYSICAL SOCIETY (University College), at 5.—On Unilateral Electric Conductivity over Damp Surfaces: Prof. F. T. Trouton, F.R.S.—The Construction and Use of Oscillation Valves for Rectifying High Frequency Electric Currents: Prof. J. A. Fleming, F.R.S.—On the Use of the Cymometer for the Determination of Resonance Curves: G. B. Dyke.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Waves: F. K. Stevens.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 26.

SOCIETY OF ARTS, at 8.—Fire, Fire Risks, and Fire Extinction: Prof. Vivian B. Lewes.

INSTITUTE OF ACTUARIES, at 5.—Some Aspects of Registration of Title to Land: J. R. Hart.

TUESDAY, MARCH 27.

ROYAL INSTITUTION, at 5.—The Influence of Geology on Scenery: Dr. J. E. Marr, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued Discussion*: The Outer Barrier, Hodbarrow Iron Mines: H. Shelford Bidwell.—The Harbours of South Africa: C. W. Methven.

WEDNESDAY, MARCH 28.

SOCIETY OF ARTS, at 8.—Coal Conservation, Power Transmission and Smoke Prevention: A. J. Martin.

THURSDAY, MARCH 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Dilatational Stability of the Earth: Lord Rayleigh, O.M., P.R.S. On the Observations of Stars made in some British Stone Circles. Second Note: Sir J. Norman Lockyer, K.C.B., F.R.S.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company: C. P. Sparks.—Electric Winding, considered Practically and Commercially: W. C. Mountain.

FRIDAY, MARCH 30.

ROYAL INSTITUTION, at 9.—Recent Progress in Magneto-optics: Prof. P. Zeeman.

SATURDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

CONTENTS.

PAGE

THURSDAY, MARCH 29, 1906.

STARS AND NEBULÆ.

The System of the Stars. By Agnes M. Clerke. Second edition. Pp. xvi+403. (London: A. and C. Black, 1905.) Price 20s. net.

THERE is much excellent sense in the French proverb, "Prends le premier conseil d'une femme, et non le second," which expresses the view that the intuitive instinct of a woman is a safer guide to follow than her reasoning faculties; and although in these days it is considered ungracious to make this suggestion, evidence of its truth is not difficult to discover in most literary products of the feminine mind. It is no disparagement to Miss Clerke to say that even she shares this characteristic of her sex, so that sometimes she lets her sympathies limit her range of vision in the field of stellar research. No doubt this disposition is exercised unconsciously, but what is an attractive instinct when applied to ordinary affairs of life is derogatory when it influences the historiographic consideration of contributions to natural knowledge.

There are many students of science who follow the trend of a writer like Miss Clerke with lamb-like sequacity, and consider it almost a presumption to express any dissatisfaction with her presentment or interpretation of scientific fact. It is a sign of weakness to occupy a position of this kind; and particularly so when the author whose views are accepted is not actively engaged in the investigation of the field surveyed. Science is not a persuasion in which personal opinion has to be respected whatever the value of the material evidence in its support. We may admire Miss Clerke's literary skill and be impressed by the brilliant periods in which she frequently encloses simple matters of fact, but, at the same time, we may be permitted to recollect that she is a bibliographer rather than an observer, and therefore her works, be they never so distinguished as literature, need only be regarded as narratives by a spectator, when the weights of the results and conclusions recorded in them are being decided. There is, as Francis Bacon knew, a vast difference between opinions based upon the study of books and papers and those derived from individual observation and experience. "Studies themselves doe give forth Directions too much at Large, except they be bounded in by experience. Crafty Men Contemme Studies; Simple Men admire them; And Wise Men Use them. For they teach not their own Use; But that is a Wisdome without them and above them, won by Observation."

This statement of Miss Clerke's position is necessary by way of excuse for the temerity of a reviewer who ventures to criticise some points in a work of such a substantial character as the present one. The book has been revised so completely that scarcely a page of it remains the same as in the original edition published fifteen years ago. In this period much new work has been accomplished, and from it Miss Clerke has selected what she considers to mark essential steps in the progress of sidereal science, to incorporate with the results previously described. The task of sidereal astronomy was formerly stated to be the investigation of "the nature, origin and relationships of sixty million stars and upwards of eight thousand nebulæ," but the numbers are now "30,000,000 stars and 120,000 nebulæ." The discovery of terrestrial helium has led to the recognition of a new stellar type having helium rays prominent in their spectra, while oxygen, silicon, and titanium are among other substances the rays of which have been identified in celestial bodies in recent years. Numerous stars have been proved by the spectroscope to be close couples; and "Prof. Campbell showed in 1902 that, among the entire multitude of stars, one in six or seven is so constituted." From spectroscopic observations, it has also been possible to determine that the solar system is moving toward an apex in right ascension $277^\circ\ 30'$ and declination $+20^\circ$ at the rate of $12\frac{1}{2}$ miles a second, the probable error of the result being less than one mile a second. The demonstration of the motion of nebulæ in the line of sight has shown that there is no difference in this respect between nebulæ and stars, and has thus removed a difficulty formerly offered to the view that stars arise from a condensation of nebulous matter. Finally, the large number of variable stars found in certain globular clusters, the phenomena presented by such temporary stars as Nova Aurigæ and Nova Persei, and the structure and distribution of nebulæ in relation to the Milky Way, can only be simply and sufficiently explained by the existence in space of clouds of obscure particles alone or associated with luminous matter. The most noteworthy discoveries of astronomical science in recent years are, indeed, those which demonstrate or suggest that space may include as much dark material as bright.

Until a few years ago it was believed that nebulæ are masses of glowing gas at a high temperature; but Miss Clerke is now able to write, "experience is wholly contradictory of the notion that nebulæ are excessively hot bodies." It is scarcely too much to say that the evidence brought forward by Sir Norman Lockyer in connection with his meteoritic hypothesis of celestial evolution is chiefly responsible for the change of view that has taken place. An astronomer unfamiliar with the literature of astrophysics would not, however, derive this impression from the study of any parts of this book in which nebulæ are dealt with. Again, it is stated that a consensus of opinion regards gaseous nebulæ as being "luminous through electrical excitement"; but though this is frequently mentioned, there is no record of the suggestion made in 1888, as the result of spectroscopic examinations of meteorites, that in the Orion nebula "the hydrogen is electrically excited"; yet this observation was recorded in the original edition of Miss Clerke's book.

The low temperature of nebulæ, electrical excitation as a cause of luminosity, and the suggestion that the apparently continuous spectrum of white nebulæ, like the nebula of Andromeda, would prove to be an interrupted band of colour, are all functions of the meteoritic hypothesis. These three points have been

 Z

specifically and repeatedly mentioned in connection with the hypothesis, as, for instance, in the remark that the general absence of bright lines of metallic vapours, and of the bright lines of hydrogen in white nebulæ "evidently justifies the conclusion that we are here in presence of those bodies in celestial space, the temperature and the electrical excitation of which are at a minimum, and as the continuous part of the spectrum is brought under examination further stages will be recognised. . . . There can be little doubt that when our instrumental appliances and observing conditions become more perfect, it will be found that the so-called continuous spectra will be a perfect mine of new knowledge regarding the true nature of the changes which occur as condensation increases" ("Meteoritic Hypothesis," pp. 323, 324).

This was written sixteen years ago; and the work that has since been done enables Miss Clerke to arrive at the same conclusions, though she has forgotten the observations which have changed the position formerly occupied. She can now write:—

"Gaseous nebulæ are, in fact, reasonably believed to be at a temperature not much above absolute zero. They are not, then, incandescent, but rather 'luminescent'; their light is independent of thermal conditions."

Also we find in several places the view accepted that even the spectra of white nebulæ are not truly continuous, but show

"slight inequalities in the flow of light, indicating effects of absorption, of emission, or of both combined."

In the present state of knowledge of nebular spectroscopy, no opinion of substantial value can be expressed as to the relationship existing between nebulæ exhibiting the characteristic line at λ 5007 alone or with other lines, and nebulæ with apparently continuous spectra, but the view that the difference is due to different degrees of condensation of congeries of meteoritic matter—cosmic dust—the Andromeda type of nebula being in a more condensed condition than an irregular nebula like that of Orion, is at least as reasonable as any other. Even if this suggestion is considered to be of negligible value, there remains the fact that the present tendency is to regard the spectra of all nebulæ as being really discontinuous, as was anticipated in the meteoritic hypothesis. Moreover, Miss Clerke admits that, apart from the question of the apparent differences between the two spectroscopic types of nebulæ,

"relationship between the various orders of nebulæ is manifest. The tendency of all to assume spiral forms demonstrates, in itself, their close affinity; so that to admit some to membership of the sidereal system while excluding others would be a palpable absurdity. And since those of a gaseous constitution must be so admitted, the rest follow inevitably."

It is not clear from this, or from other remarks in the book, how we are to regard the white nebulæ, if only as a working hypothesis. Most spiral nebulæ do not give the characteristic spectrum of hydrogen and helium, yet it is agreed that all spiral forms are closely related. If it is assumed that the spiral nebulæ with bright line spectra are entirely gaseous in constitution, it is difficult to explain the existence of apparent "stars," presumably at a higher temperature than that of the general mass of gas, threaded upon the spirals. If, however, the view is accepted that the luminous radiations of so-called "gaseous" nebulæ are really only the visible manifestations of electric or dynamic disturbances of a mass of cosmic dust—and few would now deny the existence of dark matter in nebulæ—the explanation of spiral nebulæ is easy, and the difficulty as to the relationship between these nebulæ and others disappears. The existence of streams, sheets, and shells of palpable matter intersecting at various points is sufficient to account for the bright portions of spiral nebulæ with the apparent stars arranged along the spirals; if nebulæ have this meteoritic constitution spiral forms ought to predominate, as they actually do. Spiral nebulæ like those of Andromeda and Canes Venatici are certainly not purely gaseous in constitution, though a few years ago it was more necessary to insist upon their non-gaseous nature than it is now; but while we await crucial observations to decide how nebulæ of different spectroscopic types are related, Miss Clerke might have shown that an explanation has been given, though she may disapprove of it.

A knowledge of the constitution of nebulæ is of fundamental importance, for upon it must be based any satisfactory scheme of evolution of celestial species. All astronomers accept the idea of evolution from nebulæ, but as to the order of development, and the means by which it is brought about, no hypothesis has met with general adoption, even as a working principle. A common ground of agreement, however, is that nebulæ showing the characteristic trio of lines—λλ 4860, 4950, and 5007—in their spectra are at a relatively low temperature. Given the cosmical amœba in the form of a nebula, what will become of it? The question cannot be answered directly, because sidereal ontogeny transcends human experience; but though the development of the individual nebula cannot be followed, a sidereal phylogeny can be based upon the spectroscopic characters of celestial species. Miss Clerke does not deal with nebular and stellar spectra from the point of view of development; for she takes Secchi's four types of spectra as her groups for discussion, and only makes incidental reference to the stages occupied by particular stars in an evolutionary scheme. The helium-stars, typified by certain stars in the constellation Orion, are regarded as the first results of condensation from nebulæ; Sirian stars represent the next stage, and then the solar condition is reached.

"In a general sense it may indeed be said that the spectra of the sun and of solar stars imply a state of things in their reversing layers analogous to that prevailing in the arc-light, while in helium and Sirian stars the conditions of the spark are more nearly reproduced."

From stars of the solar type, Miss Clerke suggests that the development is toward the condition of Betelgeux, which exhibits the Fraunhofer spectrum in

association with titanium flutings or bands, then to α Herculis, in which "the bands have acquired strength through the efflux of time, it is supposed, and the progress of cooling." Further than this she does not go, Secchi's fourth type of stars, showing absorption flutings of carbon in their spectra, being regarded as a class apart, and not united to the sun and its congeners in an evolutionary series.

In this classification of stellar spectra, temperature is not considered as an essential factor or a concomitant of the changes described; the question of the temperatures of the stars forms the subject of a separate chapter, new to the present edition. Heat is not entirely discarded, but "luminescence," "radiology," and "electrical excitement" now appeal to Miss Clerke's affections, and she flirts with them whenever she has the opportunity, though little is known of their resources. By this course she is able to believe, with Sir William and Lady Huggins, that solar stars are hotter than Sirian stars, while she acknowledges, as has been shown, that arc-lines are characteristic of the former type of spectra and spark-lines of the latter. Whether the temperature of the electric spark is actually higher than that of the arc has yet to be decided, but solar stars can only be placed at a higher temperature-level than white stars by neglecting much circumstantial evidence in support of the superiority of the spark. As a matter of fact, laboratory observations, so far as they are available, show that the same spectra can be produced by thermal or electrical action. Under conditions from which electrical influences were probably excluded, and the spectra obtained were due solely to high temperature, nitrogen at temperatures above 3000° C. has been found to give an emission spectrum in which the principal lines characteristic of the element were visible (Nasini and Anderlini, *Atti dei Lincei*, July, 1904). The agency by which gases and vapours are rendered incandescent seems, indeed, to be inconsequential, and high temperature is probably competent to produce the same spectroscopic results as those observed when incandescence is caused by the oscillatory discharge.

Electric and thermal effects cannot, however, be distinguished from one another in stellar spectra; therefore any attempt at a temperature classification must provide for possible electric influences. It was recognised by Sir Norman Lockyer more than thirty years ago (Roy. Soc. Proc., vol. xxii., p. 372, section ii., June, 1874) that the action of electricity must be included in the term "temperature"; and while the chemical changes effected by thermal and electric forms of energy cannot be discriminated in celestial spectra, the aim should be to construct a chemical classification without waiting for a complete understanding of the active causes of atomic vibrations or molecular combinations revealed by the spectroscope.

From whatever point of view stellar spectra are studied, little support can be found for the conclusion that the solar stars are at a higher temperature-level than the white stars. From a comparison of the spectra of Capella and Vega—typical solar and white stars respectively—Sir William and Lady Huggins concluded that "The solar orb seemed intrinsically the *bluer*, and was inferred to be the hotter of the two"; but neither the observation nor the inference can be regarded as established. Adopting the relative length of the ultra-violet spectrum as a criterion of stellar temperature, observations show that solar stars are really weaker in ultra-violet rays than white stars. In a paper on "Radiation through a Foggy Atmosphere" (*Astrophysical Journal*, vol. xxi., No. 1, January, 1905) Prof. Schuster accepts "the comparative weakness of the ultra-violet radiation in solar stars" as a fundamental fact which he attributes to molecular scattering in the photospheric regions of these bodies; but whatever the explanation, it is clear that spectroscopists have not adopted Sir William and Lady Huggins's view as to the ultra-violet spectrum of solar stars, but hold an opinion directly opposed to it. The extension of spectra into the ultra-violet may be regarded as the result of increased temperature, but by this standard white stars are placed above solar stars, and not below them.

All standards of comparison should, however, lead to the same spectroscopic succession if they are true tests of evolutionary development of celestial species. The sequence derived from comparisons of the lengths of ultra-violet spectra is the same as that revealed by the presence of gaseous and metallic lines of helium and hydrogen, and the enhanced and arc lines of the metals. In stars which have relatively the longest ultra-violet spectra there are few absorption lines; iron is represented practically by the enhanced lines alone, and the lines characteristic of the arc spectrum are almost or entirely absent. Only by considering the length of the ultra-violet spectrum together with the presence or absence of iron lines and lines that are intensified in passing from the condition of the arc to that of the spark can a useful classification of stellar spectra be established. When this principle is adopted a chemical classification of spectra becomes possible, and a reasonable scale of stellar thermotics is arrived at. From a hot star like Bellatrix a descending series can be arranged through β Persei, γ Lyræ, Sirius, Castor, and Procyon to Arcturus—a relatively cool star—by considering the changes in the spectrum of any constituent in passing from one grade to another. A continuous ascending series of spectra reaching up to Bellatrix can also be arranged from the spectrum of nebulæ of the Orion type through planetary nebulæ and the Wolf Rayet stars showing the line λ 4688 in their spectra to Orion stars in which this line is dark. This arrangement of spectra corresponds also with the sequence which would be expected as the result of various degrees of chemical dissociation at different temperatures. Stars having the smallest number of chemical elements represented in their spectra are probably the hottest, while an increased number of lines in other spectra is probably due to the existence of an increased number of chemical elements as the result of lower temperatures, the inferior position on the temperature scale being indicated also by the reduction of the relative length of the spectrum, increase of the relative intensity of red radiation and general absence of

enhanced lines. Little is said about this chemical classification by Miss Clerke, and nothing in its favour, yet it represents the conclusions of a lifetime devoted to the study of spectra in the laboratory and observatory, and abundant material relating to it appears in the Proceedings of the Royal Society. Anyone unfamiliar with this material who reads what Miss Clerke has to say upon the temperatures of the stars and the interpretation of stellar spectra would have an inadequate idea of the results of systematic studies of these subjects, or of the existence of substantial ground of appeal against her verdict.

An instance of an incomplete statement that tends to mislead the reader is afforded by the note on Sir William and Lady Huggins's experiments on the behaviour of the H and K lines of the spectrum of calcium (Roy. Soc., June 17, 1897). By reducing the density of calcium vapour the lines H and K were obtained alone, and it was concluded that the various appearances of calcium lines in celestial bodies were due to the different states of density of the gases from which the lines were emitted or absorbed, and not to degrees of dissociation. The H and K lines in the solar spectrum are considered to prove the existence of "the metal calcium in a highly rarefied state"; and upon this evidence, referring to the condition of this element, Miss Clerke remarks:—"The hypothesis of its dissociation in the sun thus remains unverified." As a matter of logic, the experiments only prove that the H and K lines of calcium are spectroscopically persistent, and were able to survive (as might have been expected) conditions which effaced weaker lines in the spectrum of the element. Because brachiopods belonging to the genus Lingula are found in the sea at the present day as they were in Palæozoic ages, while many other forms that were contemporary have disappeared, we do not conclude that organic evolution is impossible, but only that the organism represents a type which persists in spite of changes of conditions. In the same way the continued existence of the H and K lines affords no evidence whatever against the view that there are different molecular groupings of calcium at different temperatures. By reducing the density of the calcium vapour, Sir William and Lady Huggins reduced the quantity acted upon; so the dissociated condition represented by the appearance of H and K alone was reached sooner. Similar experiments were made by Sir Norman Lockyer in 1879, and the conclusion arrived at was that a reduction in the quantity of a substance generally simplifies the spectrum. "In all probability the effects hitherto ascribed to quantity have been due to the presence of the molecular groupings of greater complexity. The more there is to dissociate, the more time is required to run through the series, and the better the first stages are seen" (Roy. Soc. Proc., vol. xxx., p. 26).

It will be seen, therefore, that the principal point of Sir William and Lady Huggins' experiment on calcium vapour at different densities was the subject of laboratory experiments more than twenty years earlier, and that their conclusion, though it is mentioned by Miss Clerke without reservation or reference to previous investigations, is not a safe one to apply to the consideration of the condition of calcium in the sun or stars as indicated by spectroscopic appearance. Moreover, if the changes of the calcium spectrum are interpreted as effects of tenuity, the similar spectral variations of magnesium and iron ought to admit of a like explanation, whereas there is good evidence that they are due to constitutional changes brought about by thermal or electric action.

Many other debatable matters are dealt with by Miss Clerke in a manner which suggests that the last word has been said upon them when she is really only presenting one side of a case. It may be assumed that, like a good advocate, she is as familiar with the defendant's case as she is with the plaintiff's, but the real strength of the evidence opposed to the views she adopts could only be shown by the disciple of another school of spectroscopy; and a small volume would be required to plead this cause. No writer on astronomy has a more facile pen than has Miss Clerke, and we can forgive the occasional florid style when we remember the vast amount of reading and careful analysis involved in the preparation of a volume of this kind. The work is so good that every student of astronomical physics must be familiar with it, and every astronomical library must include it. Because of its essential qualities it is to be regretted that a broad view has not been taken of all contributions to the subject made by competent investigators; for by neglecting such aspects as have been referred to in the foregoing paragraphs an incomplete story is presented of the meaning and mysteries of sidereal development revealed by spectroscopic research.

R. A. Gregory.

BRITISH ASCIDIANS.

The British Tunicata: an Unfinished Monograph. By the late Joshua Alder and the late Albany Hancock. Edited by John Hopkinson, with a History of the Work by the Rev. A. M. Norman, F.R.S., &c. Vol. i. Pp. xvi+146+xx plates. (London: Printed for the Ray Society, 1905.) Price 12*s*. 6*d*. net.

THERE are probably few precedents for the publication of an unfinished biological monograph thirty years after the authors penned their last remarks, especially of a monograph dealing with a group which has been the object of much detailed investigation by other hands in the interval. The chequered history of the present work is briefly, but sympathetically, told by Canon Norman, from whose preface the following paragraph may be extracted:—

"Though so many years have elapsed, the value of this Monograph is great, since (1st) it contains full descriptions with illustrations of the Tunicata of our fauna as known up to the time of the death of the authors; (2nd) because many of the new species had been only briefly diagnosed, and the fuller descriptions and figures of these which are now given will enable them to be better known and understood; and (3rd) it is especially desirable that the full account of Hancock's investigations should be published together with a portion of his beautiful drawings."

For these reasons the student of the Tunicata cannot be otherwise than grateful to the Ray Society for the publication of this work, and especially for the liberality with which it has been illustrated. The coloured figures representing many of the authors' species must rank among the best figures of ascidians extant, and the numerous collotype reproductions of Hancock's drawings of the branchial sac, &c., will greatly facilitate the task of identification.

The first volume, which we hope may soon be followed by the remainder of the work, contains (1) the authors' introduction (a historical summary of British records of Tunicata up to the year 1870), (2) a reprint of Hancock's paper "On the Anatomy and Physiology of the Tunicata" (published by the Linnean Society in 1867), and (3) an account of thirty British species referred by the authors to the genus Ascidia. Two of these so-called species are now described for the first time, viz. *Ascidia amoena* and *Ascidia Morei*.

It is no discredit to the memory of the distinguished authors of this monograph, whose general accuracy of observation has long been established, if we express a conviction that no modern expert in this group of marine animals will be prepared to recognise the claims of half Alder and Hancock's "species" to specific rank. It is not improbable that the thirty forms described in the monograph will be ultimately referred to some ten or twelve "good species" at most.

Excluding *Ascidia canina*, the relations of which to *Ciona intestinalis*, L., appear, strangely enough, to have been overlooked by Hancock, the remaining twenty-nine species of Ascidia, as described by the authors, would in these days be referred to the three genera Phallusia (with the single species *mamillata*), Ascidia and Ascidiella of Roule. Adopting for the moment Alder and Hancock's specific names, and confining our attention to the forms dealt with in their monograph, we may say that each of the genera Ascidia and Ascidiella includes three main types. To Ascidia (*s. str.*) belong (1) *mentula*, with which *robusta*, *rubicunda*, and *rubrotincta* are probably synonymous; (2) *mollis*, with *crassa*, *plana*, *Alderi*, and possibly *rudis*, as allies; and (3) *plebeia* (=*conchilega* of Müller), with which *producta*, *inornata*, and *depressa* are closely related or synonymous. To Ascidiella belong (1) *obliqua* (=*prunum* of Müller), to which the new species *amoena* appears to be related; (2) *venosa*, and (3) a large series of very variable forms referable in the main to the types *sordida* (=*virginea* of Müller), *scabra*, and *pustulosa* (=*aspersa* of Müller), of one or other of which the authors' "species" *elongata*, *aculeata*, *Morei*, *Normani*, *affinis*, *elliptica*, *pellucida*, *orbicularis*, and *vitrea* appear to be merely varieties or local forms.[1]

There is probably no group of animals in which external conditions exert a greater influence upon the size, shape, and structure of the body than in the case of the ascidians, owing to their permanent fixation under the most diverse natural conditions, their mode of feeding, and the plastic character of the test which serves them for a skeleton. Differences in the supply of food alone—and no factor is liable to greater extremes than the amount of phytoplankton in littoral waters—must influence the development of an ascidian's body in so many different ways that great variability must be the rule rather than the exception. In these circumstances it is doubtful if the natural history of this group can be adequately treated in any monograph until much additional work has been done, not only in the systematic observation of the nature and extent of local variations, but also in direct experiments concerning the effect of different conditions upon the growth of the progeny of selected parents. Until such work has been done, any attempt to define specific limits within (*e.g.*) the *virginea-scabra-aspersa* group must remain a mere expression of personal opinion.

In the meantime the publication of the present work is likely to lead to the clearing up of many uncertainties, provided it is regarded mainly as a repository of facts, and not as an authoritative guide to the classification or nomenclature of the group.

This aspect of the work has been fortunately retained under the editorship of Mr. Hopkinson, who has restricted his notes to the addition of such bibliographic and distributional records, published prior to 1871, as were necessary for the completion of the authors' MSS. up to the date of Hancock's latest work. The editorial footnote "on the intimate relationship existing between the Tunicata and the Polyzoa," on the first page of the authors' introduction, conveys just the right touch of archaic suggestiveness.

We notice a couple of misprints: Weigmann for Wiegmann (pp. 7 and 12), and Mongula for Molgula (p. 46); and may point out that Figs. 8 and 9 on plate xi. represent not "probably a variety of *Corella parallelogramma*," but Hancock's own species, *Corella larvaeformis*, which we presume will be described in the second volume of the monograph.

W. GARSTANG.

[1] For a fuller discussion of the relations of particular species special reference should be made to Prof. Herdman's paper in *Jour. Linn. Soc.*, xxiv., 1893, and Hartmeyer's "Holosome Ascidien" in "Meeresfauna von Bergen," 1901.

THE METALLURGY OF IRON AND STEEL.

Elementary Practical Metallurgy, Iron and Steel. By Percy Longmuir. Pp. xiii+270+13 plates. (London: Longmans, Green and Co.) Price 5s. net.

WORKS on practical metallurgy have generally consisted of descriptions of series of experiments suitable for performance in an ordinary laboratory possessing the usual equipment with small assay furnaces; but this book is an elementary work on the metallurgy of iron and steel, written with the view not only of serving the needs of the ordinary beginner among students, but of attracting the severely practical man to the study of metallurgical literature, and thus helping him ultimately to the position of being able to throw the light of new discoveries on his daily work, and to make application of suitable results—evidently a practical apostle of the methods of the British Science Guild. The writer thoroughly agrees

with the author that "Such a work should not be overloaded with detail, but the facts presented should be accurate and the matter reliable," for nothing more certainly repels the very specially practical man than a mass of finical hedgings, which are only fit for discussion among philosophers, but do not affect the main present issues. While this is so, looseness of expression is the last thing to permit oneself, as no type of man more appreciates accurate statements if they are simply expressed. While the author has in the main succeeded in his ideal, there are some points which the writer would change. Thus, p. 7, "Elasticity . . . is the length to which . . . ." Similarly, tenacity, breaking load, ductility, and ductility as applied to wire-drawing are not satisfactory. Interesting and simply written chapters on refractories, iron ores, and the blast furnace follow. The author's wide practical experience in foundries lends a special interest to his chapters (vi. to ix.) on pig- and cast-irons, for in the works he was daily brought into contact with the adjustment of those properties of cast-iron to the fulfilment of the orders on hand, and this may account for his almost bitter treatment of the enemy, sulphur, which is perhaps not quite so black as he has painted it.

These chapters should also show why there is such a fascination in the study of this complicated material. Next comes a good chapter on malleable cast-iron, but a statement on p. 128 is a little confusing. British malleables are said to contain something like 0·3 per cent. S, which agrees with the writer's experience. Then it is stated that grey hæmatite refined is used, but this would really contain less than 0·1 per cent. S. The fact seems to be that a material called refined hæmatite, but really white hæmatite re-cast into small pigs, is used, and the old refined grey pig is not obtainable on the open market.

In comparing the Siemens and Bessemer processes, the important point of the much smaller percentage of loss in the open-hearth seems to have been omitted. The crucible, Bessemer, and open-hearth processes are described in considerable detail, and p. 227, on the production of sound steel, is excellent, while it was only to be expected from the author's researches that the influence of casting temperature would be adequately dealt with. Chapters xviii. and xix., on the metallography of the heat treatment of steel and of hardened steels, are profusely illustrated, and deal with the subject from the carbonist's point of view, with the intimation that there are other theories, a wise decision, as whichever of the many theories may prove to be the correct one, that given is the easiest to understand, and the reader may search out the others if so minded. The author, in using for illustration microsections of articles he has used, such as hack-saw, table-blade, razor, and file, sets the seal on his desire to attract the practical man, and if on examining similar tools he should find different structure it ought to stimulate inquiry. The final chapter on special steels, while good in itself, will impress on the reader that there is much—very much—more beyond. The work, which is printed on matte surface paper, most agreeable to the eye, with thirty-one of its sixty-four illustrations printed on smooth paper to bring out the required detail, can be recommended to the beginner as a "book which will primarily awaken interest."

A. McWilliam.

OUR BOOK SHELF.

Glue, Gelatine, and their Allied Products. By Thomas Lambert. Pp. xii+153. (London: Chas. Griffin and Co., Ltd., 1905.) Price 5*s*. net.

This is a handbook intended for the use of glue manufacturers, agriculturists, and students of technology. It describes the preparation and properties of glue and gelatin, and also of certain side-products, such as size, cements, and fertilisers. The description is written chiefly from the practical standpoint, though some notes on the chemistry of the products are included. Diagrams of plant and machinery illustrate the working of the various processes mentioned in the text.

While the book contains much trustworthy information, there is some confusion in its arrangement. Thus the first chapter purports to be "historical," but it deals principally with matters quite other than historical; as, for example, "chondrin and its properties," "railway accommodation," "water supply," and so on. Moreover, it would, we think, have been better if the author had written either specifically for manufacturers or specifically for the manufacturing chemist, instead of addressing himself sometimes to the one and sometimes to the other. The manufacturer, for instance, hardly wants a detailed description of Kjeldahl's method of determining nitrogen; on the other hand, the chemist might well be spared the statement that "all crops contain certain mineral matters in their ashes."

The book would form a good nucleus for better things. With some re-arrangement of its subject-matter, and a less superficial treatment of the chemistry involved, it might develop into an excellent manual of the technology of glue and gelatin.

C. S.

Webbia-Raccolta di Scritti Botanici pubricati in occasione del 50° anniversario della Morti di Fillipo Barker Webb. Edited by Prof. U. Martelli. Pp. xi+393. (Florence: S. Pellas, 1905.)

Philip Barker Webb, in whose honour this volume has been compiled, lived in the first half of last century; during his career at Oxford he developed a taste for the classics and natural history which a substantial patrimony allowed him to cultivate. In the course of his travels he visited Spain, Portugal, the Canary Islands, and other countries, combining botany and geology with pleasure. He resided generally in Paris during the intervals between his journeys, and there he directed and carried out the work in connection with the "Phytographia Canariensis"; also he accumulated a large herbarium, including several French collections. At his death his botanical treasures were lost to France, as he bequeathed all his plants and books, together with a sum of money for their maintenance, to the Grand Duke of Tuscany.

This volume contains a number of original papers that have been contributed by Italian botanists as a token of gratitude for the stimulus which these collections have given to Italian botany. Most of the papers are concerned with systematic botany. Prof. O. Beccari, writing about palms, contributes an account of the Indian genus Trachycarpus, allied to Chamærops; a list of species from New Guinea, in-

cluding a new genus, Barkerwebbia, under the Arecineæ, and a revision of the order for the Philippines. Prof. U. Martelli describes a number of new species of Pandanus. A review of European umbellifers, in which the writer includes the Araliaceæ, forms the subject of a lengthy paper by Dr. B. Castellani. Prof. E. Bartoni publishes a short MS. by Parlatore on Linnæus's herbarium which is especially appropriate, as Webb and Parlatore were friends, and held each other in mutual esteem.

A Course in Mathematical Analysis. By Édouard Goursat. Translated by E. R. Hedrick. Vol. i. Pp. viii+548. (London and Boston: Ginn and Co., n.d.) Price 16*s*.

This readable and trustworthy translation will be welcome to those who cannot enjoy the original, the merits of which are by this time well known. The typography is unusually good, and is very creditable to all concerned, such symbols as the square of a_1, or even of a', being printed in a satisfactory way, which English printers might imitate with advantage. There are a few terms here and there which are ungrateful to an English ear; "involutionary" or "involutional" would be more agreeable to analogy than "involutory," and "nappe" is retained instead of being rendered by "sheet." But these are trifles, and those of us who have no French can now study a treatise which is eminently lucid and attractive, as well as being up to date and sufficiently rigorous for the purpose it is designed to fulfil.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Agriculture and the Empire.

The article by Sir W. T. Thiselton-Dyer in your issue of March 22 is a fair statement of the position the Home Country should take in the development of agriculture in the Empire at large, and of the necessary training the future experts and researchers in Indian agriculture should receive; and this view requires pressing upon those responsible for the development of agriculture in our colonies, so that the policy of employing as agricultural experts men with a mere smattering of scientific method, combined with a more or less thorough knowledge of British agriculture, may not be followed. Investigation and careful research are wanted, and the only men who can perform this are those whose sense of proportion and scientific methods of attack have been developed by a systematic training in the sciences having a bearing on agriculture. Agriculture is at once a science, an art, and a business, and the successful agriculturist at home must be a man equipped with an adequate knowledge of all these subjects, combined with a special ability for one or more of them.

The agricultural colleges of Great Britain afford a training in the science and art of agriculture, but on the business side of the subject not much can be attempted, as personal experience and responsibility of the individual for his business transactions are necessary conditions. Many agricultural colleges and agricultural departments of our universities possess the necessary scientific equipment and a staff of adequate attainments to give to the future Indian or colonial expert a thorough systematic training in such sciences as chemistry, botany, and zoology, in an agricultural atmosphere. The latter condition must be of immense importance in impressing on the student the relations of the pure science to practice: and although the practical application he will experience abroad will differ essentially from that observed at home, he will at all events be prepared to use his science to solve problems of economical value, and, if his training has been broad and thorough, to become a most useful factor in developing the agriculture of the country. It is certain that a man trained at an agricultural college or at an institution equipped with the necessary facilities for the study of animal or plant life will be better able to enter upon his duties as investigator of agricultural science in India than a man whose training has been received at the ordinary technical college. From the staff and students of this college during the past few years experts have gone: to South Africa, four, including the director of the Transvaal Agricultural Department; to India, four, including two to Pusa; to British Guiana, the West Indies, and Egypt, two, as well as to other countries, so that it can claim some connection with agriculture in our colonies.

Sir W. Thiselton-Dyer says that notice should be given five years in advance of the requirements for trained men; with this opinion I agree, though I doubt its practicability. What we require is more men of recognised ability to train for such position. Hitherto some branch of technical work other than agriculture has been the object, to a great extent, of the trained student, but now that there is a future for highly trained men who will bring their scientific knowledge and spirit of investigation to bear upon the problems of agriculture at home and abroad, we hope that men of the right stamp will come to be trained partly perhaps in this country, and afterwards under the conditions in which their future work will lie, but in any case to go through a complete course of systematic study in the science to which they intend to devote themselves when they have gained their technical experience. It is a fact, and one to be deplored, that the agricultural students are not always drawn from the best of our rising generation, since farming is looked upon as the profession to be engaged in by those "who are too clever for the Army and not stupid enough for the Church"; but now that we can offer a field for a well trained man to make a name and a living in the domain of agricultural research, we should secure a greater proportion of suitable men. In this country, for the researcher, apart from the teacher, there is little chance for a trained man to earn a livelihood, but abroad, where the resources of the soil have yet to be developed, there is a good prospect of employment for men who are thoroughly equipped with the requisite scientific knowledge and possess the spirit of investigation.

Another point to which Sir W. Thiselton-Dyer has directed attention is the proper teaching of science in our rural elementary schools, and, I would add, our rural secondary schools. How often do we see, especially in the latter class of school, the teacher (who is often selected for his chemical knowledge) teaching by book alone, and without reference to the conditions amid which his scholars live. Chemistry is one of the least suitable of the natural sciences to teach children whose lives will be, or ought to be, spent in the country. Botany or zoology taught by a teacher who has learnt these subjects, and has been trained in their application to outdoor life as it exists in an English farm or country village, would be far preferable, and I venture to think that Kew, the agricultural departments of our universities, and our agricultural colleges could supply such teachers, and so could influence to a considerable extent the value of the teaching in country districts.

The Board of Education has, I understand, the latter matter in hand, and I trust that under the advice of their excellent rural inspector a scheme will be formulated which will in some way check the tendency of modern education to prepare solely for town life. M. J. R. Dunstan.

South-Eastern Agricultural College (University of London), Wye, Kent, March 26.

Sea-sickness and Equilibration of the Eyes.

Many people have no doubt noticed, when travelling by sea, that the motion of the ship could be *seen* very distinctly, even when there were no hanging lamps, draperies, or fixed points, such as the horizon or clouds, within range of sight.

Some may think that seeing the motion in this way is due to the imagination receiving its suggestions from the motion of the internal organs, and especially the stomach, for I am here supposing the body to be held perfectly rigid.

From observations which I have recently made it seems evident to me that the cause for seeing the motion is entirely different.

In the first place, you can always see the motion a fraction of a second before you begin to feel it. In the second place, you cannot see a perfectly horizontal motion or a gentle vertical (heaving) motion. In the third place, watching a fixed point close to you, such as a pattern on a carpet, when the ship is pitching and rolling, is far more tiring to the eyesight than when the ship is motionless or running perfectly steadily. All this points to the appearance being due to a true relative motion of the eyes to the ship.

The eyes are suspended in their muscular settings, much in the same way as are ships' compasses in their binnacles. The eyes are, furthermore, perfectly balanced, so as to make their muscular displacements as little tiring as possible. In their normal position, the pull of gravity is exerted vertically through their centres, and the muscular mechanism is compensated for gravity.

Any angular change of position will displace the eyes just as it displaces the stomach, excepting that the eyes, being a great deal more sensitively suspended, will register the displacements more quickly. It is not, however, the motion of the eyes which strains the eyesight, but the act of resisting this motion.

If, with your eyes shut, you attempt to fix the mental representation of a point, which a moment previously you were watching with eyes wide open, you will find that, after one or two motions of the ship, the bodily feeling will precede any visual sensation which your imagination can conjure up. The imaginary point is no longer fixed, but follows the eyes as they let themselves go to the motions of the ship. No strain of the eyesight is caused by a muscular resistance, and the displacements, while felt, can no longer be seen.

ALFRED SANG.

Pittsburg, U.S.A., February 26.

Production of an Electrically Conductive Glass.

EXPERIMENTS have from time to time been made, both in England and abroad, to ascertain what ingredients are best for the purpose of producing glasses of very high electrical resistance.

The utility of a vitreous substance which would conduct electricity comparatively well does not appear, however, to have so far claimed any consideration.

I beg therefore to direct attention to a glass which has recently been made in my laboratory. Its chief feature is that it readily conducts electricity.

For the windows or cases of electroscopes and all high-tension apparatus requiring a transparent cover capable of screening off external electrical fields, this material offers many advantages. A conducting varnish is no longer required for glass which conducts electricity itself. In addition to these practical considerations, there arises the interesting question as to the process by which electricity passes through this substance—whether it is electrolytic. Its resistance varies very markedly with temperature changes. I hope later to give more precise details. The basis of the glass is sodium silicate.

CHARLES E. S. PHILLIPS.

Shooters Hill, Kent, March 12.

Interpretation of Meteorological Records.

IN discussing the records of the meteorological instruments at Canterbury (NATURE, March 15), Dr. Aitken suggests that the heavy rain which fell dragged down the higher air, and so caused the fall of 12° indicated on the thermograph curve, and he very clearly and convincingly shows the consequent effect on the barometric pressure and wind velocity. If, however, the air had been in a state of stable equilibrium previous to the thunderstorm, the effect of such a mechanical dragging down of the higher air would have been to heat by compression that air so much that the temperature would have been raised rather than lowered at the ground-level. But if, previous to the storm, the upper air had from any cause become very much colder than the lower air, the atmosphere would be in a state of unstable equilibrium, that is to say, the rate of change of temperature with height would be greater than the adiabatic rate of change due to heating by compression of descending air. In such a case the changes recorded by the various curves may have been initiated by this heavy cold air suddenly descending and displacing the lower air, which by its sudden uprising would be cooled, the moisture in it condensed, and a heavy fall of rain caused.

The lightning which accompanied this storm introduces an element of uncertainty into any attempted explanation, for we do not know yet the manner in which electric charges are generated in the atmosphere. But it seems probable that a great cooling of the higher air is an accompaniment of a state of electric tension, for it is difficult to see otherwise why a thunderstorm should be followed by a lowering of the temperature near the ground-level.

R. T. OMOND.

Edinburgh.

Oscillation of Flame Cones.

I SHOULD be glad if any of your readers could give an explanation of the cause of the following flame phenomenon, produced while experimenting with a modification of Prof. Smithells's apparatus for the separation of the cones of a Bunsen flame.

A mixture of gas and air is burned at the top of a vertical tube (made preferably of combustion tubing) about 4 feet long and $\frac{7}{8}$ inch to 1 inch in diameter, having a delicate screw adjustment for regulating the proportions of gas and air.

The air supply is carefully and slowly increased, until an almost explosive mixture is reached, and the inner cone is very short and sharp and of a light green colour. On admitting a very slight increase of air after this point, the inner cone (sometimes the two cones) descends the tube to a distance of about 2 feet, and then pauses and goes up again, re-joining the outer cone. The flame then "sharpens" again and repeats the process, and will continue to do so for several hours without further adjustment of the gas or air being made.

There is every appearance of an explosion wave being propagated, as shown by the increasing velocity of the descending flame and by the occasional emission of a note as it reaches the end of the travel.

The length of travel can be regulated by the amount of air admitted, varying from 1 or 2 inches to about 2 feet in the same tube. If it be allowed to exceed a certain limit the inner cone is extinguished at its lowest point, but immediately re-lights at the top of the tube, and then returns as before. The periodicity can be varied from about once in five seconds to once per second.

The gas pressure does not need any special regulation, the ordinary variations from a town supply not affecting the results.

The following are the points requiring explanation :—

(1) As the proportions of gas and air are constant, what is the cause of the periodic "sharpening" of the cones after meeting at the top of the tube?

(2) What prevents the explosion wave being completed, and the consequent firing back of the mixture?

(3) What causes the inner cone to return and travel up the tube, re-joining the outer one at the top?

(4) The alteration in the character of the flame (in view of the fact that the proportions and pressure of gas and air are constant) points to some form of wave motion bringing the molecules into closer contact. If this be so, what are the conditions which set up this wave motion and what determines its periodicity?

HAROLD E. TEMPLE.

Olton, Warwickshire.

THE phenomenon described in the foregoing letter is in part dealt with in a paper by Dr. Ingle and myself in the Transactions of the Chemical Society for 1892 (vol. lxi., p. 204). The continued oscillation of the inner cone is, I think, explained by the fact that the mixture of gas and air in the tube is not uniform. We have, indeed, found it necessary to use elaborate mixing appliances to make it uniform. When a portion of the mixture rich in air reaches

the top of the tube the inner cone is propagated through it and descends until it reaches a stratum richer in gas, when it re-ascends. The fluctuation in the composition of the gaseous mixture escaping from a Bunsen burner can be seen by the throbbing of the inner cone, when the air supply is considerable. I may add that in the construction of burners for the incandescent mantle great importance is attached to the perfect mixing of gas and air, since it becomes possible thereby to have a steady flame with a relatively large quantity of primary air.

The University, Leeds. A. SMITHELLS.

Gas for Heating and Lighting Laboratories.

I SHALL be greatly favoured if you will inform me which are the best "gas-making plants" for supplying a laboratory with gas derived either from coal, or paraffin oils.

Do you know anyone who has had experience of these? I more particularly incline to those easily managed and maintained, simple and inexpensive. ALEX. PARDY.

Lynne House, Albyn Lane, Aberdeen, March 7.

IF I were fitting up a large laboratory I should put in a small water gas generator and inject paraffin oil into the fuel during the period of steaming, fixing the hydrocarbons in the gas produced by passing through a superheater.

I see in the Journal of the Society of Chemical Industry for February 28 a paper by Masumi Chikashige, who had been fitting up the Kyoto University laboratory with a gas made in this way, and of which he gives the results, which appear to be very satisfactory. In the discussion upon the paper your correspondent will also find some useful hints as to the fitting up of laboratories with heating-gas where coal-gas is not available.

If he should not require enough gas to make a small carburetted water gas plant successful, and if he can get petrol or benzene, he will probably find carburetted air the cheapest thing to use. VIVIAN B. LEWES.

Royal Naval College, Greenwich, S.E., March 12.

Cooperation between Scientific Libraries.

As this subject has recently been receiving attention in NATURE, it may interest some readers to know that the Royal Society of Edinburgh is taking steps for the purpose of finding out what can be done so far as the south of Scotland is concerned. A committee, of which I am convener, has been appointed by the council, and this committee is at present engaged in obtaining information from the various libraries of Edinburgh and Glasgow. It is hoped that later on a conference will be held, at which suggestions for joint action would be considered, and an endeavour made to draw up a scheme of cooperation for consideration by the various societies and institutions directly concerned.

I shall be very glad to supply information regarding the work of the committee to anyone who is specially interested in it, and also to receive particulars of any similar work which is being undertaken elsewhere.

HUGH MARSHALL.

University of Edinburgh, March 26.

THE PROBLEMS OF GEOLOGY.[1]

THIS admirably printed book deserves description rather than criticism, since the author, in his wide range of personal observation and reading, aptly plays the critic to the views that he successively propounds. With an unnecessary assumption of modesty, he apologises in his preface for "the clumsiness of a geologist, who is more at home with the hammer than the pen." We can scarcely believe that one who has tinged even his most serious scientific contributions with the high attraction of literary style can in reality know so little of himself. Almost all the papers in the present volume state a proposition and sustain an argument. There is, perhaps, a lighter one, describing a visit to the Lipari Isles; but even this contains a theoretical explanation of a difficult problem at the end. Yet the book is entirely readable, and will serve to bring to workers in all manner of fields the views of one who holds that nothing terrestrial is foreign to the subject of geology.

The papers are of various modern dates, and might, as we venture to think, have been brought nearer to uniformity in the text itself. Corrections are introduced in footnotes; but essays need not be treated as prize-poems, to be crowned with honour, and to remain unalterable. We do not want to read, for instance, that "the boring party is at this moment at work" on Funafuti, when evidence is immediately given that the task was completed seven years back. But this is a matter of pure detail; the scientific considerations put forward are uniformly fresh, vigorous, and inspiring.

The article on "The Age of the Earth" naturally brings us to no definite conclusion, seeing that the data on which a correct judgment depends are still of the scantiest description. A large number of readers, however, rejoice in such discussions; and we even discern grounds for combat when we are asked to believe that the opening of the fossiliferous stratified series lies only twenty-six million years behind us. In the following paper, on "The Figure of the Earth," we are introduced, as general readers, to Mr. Jeans's very recent hypothesis of a pear-shaped primitive earth, and a secondary pear-shaped earth with an equatorial bulge. Lest we should pin our faith to these or any other proposed forms, we shall do well to notice the excellently chosen language in which the author places them before us. In the discussion of the earth's loss of heat, radium is held up to us (p. 63) as "threatening to destroy all faith in hitherto ascertained results, and to shatter the fabric of reasoning raised upon them." Now and again, therefore, we suspect in Prof. Sollas the artist who feels in him a mission to produce and paint, even if in perishable pigments. The pigments are not his fault; they are all that others will provide for him; but the artist in him must find expression, spite of all. After this, dare we revert to the passage in the preface in excuse of "the clumsiness of a geologist"?

The summary of the results of the famous Funafuti boring is very welcome, especially in view of the cautious absence of generalisations that characterised the Royal Society report. It is a matter of regret that von Richthofen should have passed away without reading the authoritative re-vindication of his views as to reefs in Tyrol contained on pp. 131 and 132 of the present volume.

The sixth chapter, on "The Origin and Formation of Flints," should set at rest many fantastic theories still prevalent among amateur geologists. We only wish that the numerous flints of radiolarian origin could have been included in this lucid essay. Zoologists will be especially attracted by the next chapter, on "The Origin of Freshwater Fauna" (faunas?), in which Lake Tanganyika, among other areas, is discussed. William Smith's views on the contemporaneity of similar faunas are defended in "The Key to Terrestrial History"; and an address on "Geologies and Deluges," in which objection is properly taken to Suess's reliance on the Chaldæan narrative of the deluge, concludes the varied and uniformly interesting series.

If we accept "planctone"—but would the author write "gnomone"?—the only slips that we notice in this excellent book are in proper names, Burnett,

[1] "The Age of the Earth, and other Geological Studies." By W. J. Sollas, D.Sc., F.R.S. Pp. xvi.+328. (London: T. Fisher Unwin, 1905.) Price 10s. 6d. net.

Huddleston, Birnham, and Mojsisoviks. The quotation from Tennyson on p. 233 has got astray, mainly in punctuation.

In conclusion, we would ask attention to the remarkable *tour de force,* or rather *tour d'esprit,* entitled "The Influence of Oxford on the History of Geology" (p. 219). In this, Plot's work as a "critic" is compared with that of Steno as a "prophet"; Kidd, an Oxford chemist, appears to be regarded as having furnished a serviceable brake to the wheels of Hutton's chariot; while Buckland's abandonment of the Noachian déluge as a geological factor, only to accept several deluges in place of it, is held up as a claim upon our gratitude. Here we think we see Prof. Sollas revelling in his mission as an artist; yet he paints far too frankly, and has no desire to deceive us. The pigments have been made in an ancient university; but we see right through the picture. We still prefer what we may consider as the first draft of this address, a modest pamphlet issued in Bristol in 1883, in which stress is laid on the progress of geological thought rather than on the benefits to be derived from its academic retardation.

FIG. 1.—The Sella Mass, Tyrol, the remains of a supposed ancient coral atoll. (From "The Age of the Earth, and other Geological Studies.")

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the general board of the National Physical Laboratory was held at Bushy House on Friday, March 16. There were present, in addition to the chairman, Lord Rayleigh, the following among others:—Sir John Wolfe Barry, Mr. Beilby, Mr. Kempe, Mr. R. K. Graye, Colonel Crompton, Mr. Hadfield, Mr. Gavey, and Mr. Howard.

In opening the proceedings, Lord Rayleigh referred to the great loss the laboratory had sustained by the deaths of Sir E. Carbutt and Sir B. Samuelson.

The report of the executive committee for 1905 was presented and approved for presentation to the Royal Society on the motion of Sir J. Wolfe Barry, seconded by Mr. David Howard. The scheme of work for 1906 was also approved. The report showed progress in all directions.

Some fourteen scientific papers of importance have been published officially, while members of the staff have contributed nine others to various journals.

The second volume of "Collected Papers" is in course of preparation. The scheme of work for 1906 includes a research into the resistance of materials of construction to impact, the continuation of the wind pressure and steam researches, the completion of the work with the Ampere balance, and some experiments of great interest on the effect of the continued application of high pressure to insulators. In the metallurgical division a research into the properties of aluminium bronze promises interesting results.

The report announced the intention of the Government, communicated to the Royal Society in December last, to grant a sum of 5000*l.* for buildings during the year, and the increase of the annual grant by 500*l.* It referred also to the very successful meeting in the House of Commons last August, under the chairmanship of Mr. Haldane, which led up to a petition, signed by 150 members of the House, asking that the grants should be increased, and the chairman was able to announce that the Chancellor of the Exchequer had recently intimated his intention of making the building grant for the year 10,000*l.* instead of 5000*l.*, as originally contemplated. We are able to add that this increase was largely due to an appeal to the Chan-

cellor of the Exchequer by Mr. Haldane as president of the British Science Guild.

It was also stated that the Goldsmiths' Company had very generously made a donation of 1000*l.*, with the request that it should be devoted to some specific object.

The very cordial thanks of the board were voted to the Chancellor of the Exchequer, Mr. Haldane, Sir J. Lawrence, Sir J. Brunner, and the other gentlemen who had interested themselves in the House of Commons petition, and also to the Goldsmiths' Company.

The director gave an account of the proposed additions to the buildings rendered possible by the increased grant, and explained the plans which had been prepared by the building committee. The suggestion that the work of erecting these buildings should now be pressed forward was cordially welcomed, and at a meeting of the executive committee held later power was given to the building committee to take the necessary steps. The board then adjourned to inspect the laboratory and to view the new electrical buildings, which are now approaching completion. They have been erected by Messrs. Mowlem and Co., at a cost of about 8000*l.*, to the design of Messrs. Mott and Hay, who very kindly gave their services, while with marked generosity Messrs. Mowlem's tender was based on the cost price of the buildings.

It is hoped that they may be opened on June 25 on the occasion of the visit of the foreign guests of the Institution of Electrical Engineers. In view of this ceremony the invitations on March 16 were restricted to members of the board and their personal friends, the usual annual gathering of friends of the laboratory being postponed until June.

NOTES.

A preliminary programme has been received of the events in connection with the Franklin bi-centenary, which the American Philosophical Society will celebrate at Philadelphia on April 17–20. The opening ceremony will take place on April 17, when the president, Prof. Edgar F. Smith, will deliver an address. Numerous papers on subjects of science will be read on April 18 by distinguished American men of science. In addition to these, Sir George Darwin, K.C.B., F.R.S., will read a paper on the figure and stability of a liquid satellite, and Prof. Hugo de Vries, of Amsterdam, will deal with elementary species in agriculture. Addresses will be given during the evening of the same day by Prof. E. L. Nichols, on Franklin's researches in electricity, and Prof. E. Rutherford, F.R.S., on the modern theories of electricity and their relation to the Franklinian theory. On April 19 honorary degrees will be conferred by the University of Pennsylvania, and an oration will be delivered by the Hon. Hampton L. Carson, Attorney-General of Pennsylvania. Ceremonies will be performed on this day at the grave of Franklin. On April 20 addresses in commemoration of Franklin will be given by Dr. H. H. Furness, who will speak of him as citizen and philanthropist; Dr. C. W. Eliot will pronounce a eulogy of him as printer and philosopher; and Dr. J. H. Choate as statesman and diplomatist. The presentation of the Franklin medal to the Republic of France, in accordance with the Act of Congress, will be made by the Hon. Elihu Root, Secretary of State.

Dr. Libbertz, the scientific director of the bacteriological department of the Farbwerke, Hochst a. M., is going to South Africa with Dr. Robert Koch to study the question of sleeping sickness.

We learn from the *British Medical Journal* that the donations to the fund being collected for the establishment of an Institute of Cancer Research in connection with the University of Heidelberg now amount to 34,000*l.*

An exhibition devoted to engineering and mechanical appliances will be held at Olympia from September 15 to October 17. Sir William White, K.C.B., is president, and the list of patrons includes the presidents of the various engineering societies. The offices of the exhibition are at Balfour House, Finsbury Pavement, London.

The eighth International Agricultural Congress will be held in Vienna on May 21–25, 1907. The proceedings of the congress will be carried on in eleven sections, of which section ii. will be devoted to questions on instruction in agriculture and forestry, section vi. to agricultural industry, section vii. to the protection of plants, and section x. to vine growing, &c.

A Reuter telegram states that M. Mylius Erichsen's Danish expedition to the north-east coast of Greenland will leave Copenhagen at the end of June, and will proceed *viâ* the Færöe Islands and east Iceland to the east Greenland pack-ice, through which the explorer expects to be able to penetrate into East Greenland between 57° and 77° northern lat. In addition to the Danish members, the exploring party will probably include Dr. A. Wegener, from Germany, as physicist and meteorologist, and Dr. Baron Firchs, from Russia, as geologist.

According to a Reuter message from Peshawar, a letter from the Governor of Balakh states that while some peasants were preparing their land for cultivation they came upon some ruins, which on further examination proved to be wall enclosures of a ruined city. The Governor visited the spot, and found the ruins of a large city, with some gold coins, the inscriptions on which nobody could read. Old Afghans said they had heard from their ancestors that a large Kafir (or infidel) city existed in the vicinity, which had been destroyed long since, and that in the ruins were buried the treasure of the Kafir kings. Some of the coins were sent to the Ameer for inspection.

The Washington correspondent of the *Times* states that the report of the American members of the International Commission for the Preservation of the Niagara Falls recommends that legislation be passed, based on a treaty between America and Canada, to prevent further depletion of the water, to maintain the present scenic effects, and to regulate the electrical supply companies which are using the Falls for power. It is proposed to limit the diversion of the waters on the American side to 28,500 cubic feet a second, and the diversion on the Canadian side to 36,000 cubic feet. This advantage of Canada is in reality only on paper, as the power generated on the Canadian side is used largely in the United States. The report states that the diversion of water by works already authorised is likely to injure the Falls, and will possibly leave the American fall dry. It is estimated, however, that five-sixths of the total of 60,900 feet a second authorised chiefly affects the Canadian Horseshoe Falls.

Mr. Frank Stromsten gives a good account of the anatomy and development of the venous system of various species of turtles (*Amer. Journ. of Anatomy*, iv., 1905, p. 453). About forty turtles of the more common species were dissected, and fifty turtle embryos were studied for the development of the veins. In general, the development

of the veins of the hepatic and renal portal systems is the same in turtles as in lizards and snakes, but there are important differences.

SCIENCE BULLETIN No. 7 of the Brooklyn Institute contains an account by Mr. C. Schaeffer of beetles new to the United States, and also a description, by Dr. H. G. Dyar, of new moths from Arizona. Among the latter use is made of the generic name Janassa, usually applied to a group of Palæozoic fishes. The marine ostracod crustaceans of Vineyard Sound form the subject of a paper by Mr. J. A. Cushman in the Proceedings of the Boston (U.S.A.) Society of Natural History, vol. xxxii., No. 10.

THE results of a study of the wing-structure of the hymenopterous insects of the group Tenthredenoidea, published in No. 1438 of the Proceedings of the U.S. National Museum, have enabled Mr. A. D. MacGillivray to demonstrate the origin of the modern complex hymenopterous wing from one of the simplest type. Throughout the line of evolution all the modifications have tended to render the wing more efficient as an organ of flight, this efficiency being due to the arrangement of the veins in such a manner as to stiffen the areas subjected to the greatest strain.

IN the *Verhandlungen* of the German Zoological Society for 1905 Prof. Simroth discusses the geographical distribution of land-shells, salamanders, and ganoid fishes, more especially in connection with climatic changes due to precession of the equinoxes; while Dr. K. Guenther contributes a review of theories and facts bearing on bird-migration. Special interest attaches to an article by Dr. O. Abel on the phylogenetic evolution of the cetacean dentition and the systematic relations of the Physeteridæ. Both physeteroids and ziphioids are considered to have originated, independently, from squalodonts during the Miocene, while the latter are connected with the true Eocene zeuglodonts by means of Microzeuglodon. If this phylogeny be well founded, we may accept the descent of cetaceans from creodont carnivores.

AMONG the contents of part ii. of the third volume of the quarterly issue of the Smithsonian Miscellaneous Collections is a paper on the great whale-shark (*Rhinodon typicus*), by Mr. B. A. Bean, in which figures are given of the type specimen taken at the Cape in 1828, and of an individual recently stranded on the Florida coast. This shark is stated to grow to a length of 60 feet, and is thus the next largest animal to the biggest kinds of whales. Like its relative the northern basking shark, it has a terminal mouth and feeble dentition, and is quite harmless to man. In a second article Mr. W. H. Osgood describes remains of certain ancestral musk-oxen from Alaska and other parts of Arctic America, while in a third Mr. T. Gill furnishes a very interesting account of the carp group. In the course of a paper on Mexican land-shells, Dr. W. H. Dall describes a new genus, Hendersonia, remarkable for having developed a multispiral discoid shell, with an upturned mouth, quite unlike those of its relatives.

IN the Bulletin of the Johns Hopkins Hospital for February (xvii., No. 179) the biographical sketches of medical worthies of former times, which have formed a marked and interesting feature of recent issues, are continued, the subject of this month's sketch (by Dr. Walter Steiner) being the Rev. Gershom Bulkeley, of Connecticut, born about 1635, who, having served in the ministry, was obliged to resign owing to weakness of voice, and subsequently devoted himself to the practice of medicine. Articles of medical interest, reports of societies, &c., complete the number.

IN his presidential address to the Entomological Society of London, Mr. F. Merrifield surveyed the results obtained by other investigators and himself in studies of the influence of temperature and other conditions on insects. As a result of artificial experiments, it has been found that alteration of temperature on developing insects affects to some extent the colouring of the adults. Apparently high and low temperatures do respectively make the insects tend to approximate in colouring to warmer temperate and arctic types.

THE issue of the Philippine Journal of Science, the first number of which (January) has reached us, is further proof of the manner in which scientific research is being cultivated by the American Government. The journal is well printed on paper 10 inches by 7 inches, and contains several excellent illustrations. The editors are Dr. Paul Freer and Dr. Richard Strong and Mr. H. D. McCaskey, and the contents of the present number are three articles on the cocoa-nut palm and oil, by Dr. Freer, Mr. E. B. Copeland, and Mr. H. S. Walker respectively; the occurrence of *Schistosoma japonicum* vel. *Cattoi* (a parasite fluke) in the Philippines; and a study of some tropical ulcerations of the skin, by Dr. Strong.

PROF. ADAMI discusses in an interesting paper the question of the transference of bovine tuberculosis to man through milk (*Amer. Medicine*, ix., 1905, p. 683). He holds that such conveyance is not so frequent as is generally accepted (von Behring goes so far as to attribute most human tuberculosis to the use of tuberculous milk in infancy). Kitasato has recently published statistics of the incidence of tuberculosis in Japan, which show that the deaths from tuberculosis in Japan are just about in the same proportion to the total deaths and to the total population as are the deaths from this disease in European countries; but primary intestinal tuberculosis in the young (which has been attributed to the ingestion of tuberculous milk) is rather more prevalent (30 per cent. of the total) than in Europe and America (25 per cent.). The use of cows' milk for feeding infants is unknown in Japan, and Prof. Adami therefore holds that the facts gathered in Japan show that intestinal tuberculosis, which is as frequent there as in Europe, cannot be attributed to the ingestion of infected cows' milk, and cannot therefore be of bovine origin; and the inevitable conclusion is that if intestinal tuberculosis is moderately frequent, and not of bovine origin, then similarly a large proportion of European intestinal tuberculosis is in all probability not due to infection from milk.

TWO leaflets referring to British East Africa have been received; of these, leaflet No. 12 of the Department of Agriculture, Nairobi, provides a list of forage plants with their special characteristics, and leaflet No. 2, issued by the Forest Department, deals with native trees. The list of native trees, with vernacular names and uses, is accompanied by a few hints as to the selection of suitable species, the collection of seeds, and the methods of planting.

THE Kew Bulletin for the year 1900 (Nos. 178–180) reached us a few days ago! The Bulletin, which has been in abeyance since the volume for 1901 was completed—with the exception of a part issued as No. 1, 1905—was re-inaugurated with a part recently published as No. 1, 1906. This number is devoted entirely to descriptions of

new specimens, the contents being "Decades Kewenses, xxxvi.–xl.," "Diagnoses Africanæ, xiv.," and "New Orchids, Decade 26." The first furnishes a list of ferns and flowering plants, of which the majority were collected by Dr. Henry in China. An interesting species is *Cuscuta Upcraftii*, that has been grown on potatoes from seed collected in Tibet by Mr. W. M. Upcraft. A list of staffs in botanical departments at home, in India, and the colonies has also been published as Appendix iv., 1905.

AN interesting report on the mineral resources of the Kalahasti Zamindary, Madras, has been published by Mr. V. S. Sambasiva Iyer, of the Mysore Geological Department (Bangalore, 1906). Gold, iron ore, barytes, and marble are met with. The evidences obtained and the records of old workings fully justify a detailed prospecting of the Sirasinambedu gold deposits.

IN the *Engineering Magazine* for March there is an admirably illustrated account of gypsum mining in the vicinity of Paris by M. Jacques Boyer. Interesting details are given of the calcination of the material and of the preparation of plaster of Paris. At the present time some eighty companies are engaged in the industry near Paris, and 5500 workmen are employed.

A REMARKABLE example of the surface outcrop of an iron ore deposit is illustrated in an article on iron ore in Mexico, by Mr. R. H. Anderson, in the *Engineering and Mining Journal* of New York (vol. lxxxi., No. 9). The deposit is situated on the Las Truchas creek, near the boundary of the States of Michoacan and Guerrero. The outcrop is 10,000 feet in length and 4000 feet wide. It rises to a height of 450 feet.

THE paper on smoke prevention contributed by Mr. A. J. Martin to the conference on smoke abatement at Westminster in December, 1905, has now been published in pamphlet form (London: Sanitary Publishing Co., Ltd., price 1*s*.). Mr. Martin advocates a scheme of long-distance gas transmission, and urges that a strong permanent committee be appointed by the Government to deal with the evils produced by smoky fogs, and the desirability of providing a cheap, smokeless fuel for domestic and industrial use.

THE opening number of vol. iii. of the *Bollettino* of the Italian Meteorological Society contains an interesting article on the supposed connection between rainfall and volcanic activity, unsigned, but evidently emanating from the Observatory of Catania. The author finds that whether account is taken of the daily variation in the activity of Etna during the eruption of 1892, or the whole series of eruptions the date of which is known with accuracy, there is no evidence of any connection between the volcanic activity of Mount Etna and the local rainfall; neither of these determines or is determined by the other.

THE weather during the past week has been unusually cold and disagreeable over the whole of the British Islands, the day temperatures being about 10° below the average for fifty years, with sharp frost at night, and frequent showers of snow and hail. These conditions were produced by a complex distribution of barometric pressure, the chief features of which were an anticyclone lying over the Atlantic at some distance to the west of our shores, with areas of low pressure over Germany and the south-west of France, and they were consequently accompanied by bitter northerly and north-easterly winds, whilst gales were experienced on several coasts. The following low night screen temperatures have been reported to the Meteorological Office:—22° in the Midland counties and 23° in the south of England. At Greenwich the exposed thermometer fell to 18° on the morning of March 23. Sunshine exceeded the normal amount in several districts.

THE University of Innsbruck publishes in a concise and handy form the results of the observations made at its meteorological observatory, situated about 1886 feet above the sea. The last pamphlet received contains observations and mean results for 1902, taken three times a day, together with hourly values from various self-recording instruments. The tables have been prepared by Dr. W. Trabert, which is a sufficient guarantee for the accuracy of the work. There is a useful appendix by Mr. H. von Ficker on cloud formation in the Alpine valleys from observations extending from January, 1904, to March, 1905, with valuable notes on the occurrence and behaviour of the Föhn wind. This phenomenon is well known to Alpine observers as, generally speaking, a dry, warm wind, to the influence of which the melting of the snow in the spring is chiefly due.

THE current number of the *British Journal of Psychology* (vol. i., part iv.) contains as its main feature an article by Dr. W. H. R. Rivers entitled "Observations on the Senses of the Todas," a small and possibly degenerating community of about 800 individuals, living among the Nilgiri Hills in southern India. The methods of observation were similar to those used by the Cambridge expedition to the Torres Straits. Visual acuity, colour-vision, visual illusions, tactile discrimination, tactile illusions, sensibility to pain, smell, taste, hearing, were all made the subject of tests. Of these the most elaborately treated are visual illusions, particularly the illusion of compared horizontal and vertical lines, and Dr. Rivers puts the results obtained from the Todas in this department of observation alongside those obtained from Cambridge undergraduates. In his general conclusions he lays stress on the difference in the part played by inference in the process of determining the sensory threshold, and the consequent difficulty of comparing sense-acuity in races of different culture. This play of inference reaches its greatest scope in the case of smell. In visual acuity and the tactile acuity of the forearm it would appear that the Todas have a slighter degree of sensibility than more civilised races, but they are inferior rather than superior in acuity of smell, and probably in acuity of hearing; they are also less sensitive to pain. Among other articles are those of Dr. James Ward, "Is 'Black' a Sensation?" and of Mr. W. McDougall, on "The Illusion of the 'Fluttering Heart' and the Visual Functions of the Rods of the Retina." Mr. McDougall points out that two quite distinct illusory appearances have been hitherto confused and brought together under the designation "the fluttering heart," and he claims that the true explanation of one of these is to be found in a suggestion made by Prof. J. von Kries.

IN the *Chemiker Zeitung* for March 21 is an interesting report, by Dr. E. Gerlach, dealing with the advances made by electrotechnical industries during last year. The writer deals particularly with electrical illumination, telegraphy and telephony, new accumulators, dynamo machines, electrical heating, power transmission, electrical railways, conductors and insulators, and measuring instruments.

As is well known, the carbides of different metals yield different hydrocarbons when acted upon by water. Thus while calcium carbide gives acetylene, aluminium carbide

[pr]oduces marsh gas (methane). We learn from the *Zeitschrift fur Elektrochemie* (vol. xii., p. 20) that in St. Alban, France, a carbide is now being manufactured from which ethylene is evolved when it is acted upon by water. The ethylene so obtained is pumped into sulphuric acid, by which it is absorbed with production of ethyl hydrogen sulphate. Now when ethyl hydrogen sulphate is acted upon by water, alcohol and sulphuric acid are produced. By distillation the alcohol can be obtained free from the sulphuric acid, and the sulphuric acid can again be obtained in the concentrated condition by evaporation. Furthermore, the metallic oxide which is used in the production of the carbide is again obtained when the carbide is acted upon by water, so that the production of alcohol is summed up in the equation carbon + energy = alcohol. Up to the present it has been found necessary to use four times the quantity of carbon which should theoretically be required. How much more energy it is necessary to employ than is required by the theory is not stated. We remember that so far back as 1893, when the calcium carbide industry was in its infancy, it was suggested that the acetylene might by reduction with hydrogen be converted into ethylene, and the ethylene so obtained be employed for the manufacture of alcohol. In fact, we believe that several patents were taken out upon the subject. Owing to the difficulty of reducing acetylene, the process could hardly be expected to be a success. In the present case, however, provided the formation of the carbide is not too costly and the recovery of the sulphuric acid and metallic oxide not too expensive, the process seems to possess at any rate the elements of success.

THE first part has been received of an "Atlas of the World's Commerce," by Mr. J. G. Bartholomew, which is to be published by Messrs. George Newnes, Ltd., in twenty-two parts. The parts, which cost 6*d*. each net, are to appear fortnightly.

MR. DAVID NUTT has issued a ninth edition of the late Prof. A. Milnes Marshall's well known book on "The Frog: an Introduction to Anatomy, Histology, and Embryology." The work has been edited by Dr. F. W. Gamble, who has revised the chapter on development and added some figures.

A NEW monthly periodical, entitled *Science and Technology*, price sixpence net, has just appeared. It is intended to be of interest and assistance to teachers and students. The first number contains articles dealing with educational administration, examination syllabuses, and reports of meetings. The only contribution of a wholly scientific character is a reprint of Prof. S. P. Thompson's lecture at the Royal Institution on the electric production of nitrates from the atmosphere.

A THIRD edition of Sir William Ramsay's "Gases of the Atmosphere. The History of their Discovery," has been published by Messrs. Macmillan and Co., Ltd. The first edition of the book, published in 1896, included a non-technical description of argon, discovered in the atmosphere in 1894. To the second edition of 1900 a new chapter was added describing the other four inactive gases discovered to be present in air—helium, separated from the atmosphere in 1900, and neon, krypton, and xenon, discovered in 1898, and separated from argon and from each other during 1899 and 1900. The present edition has also been enlarged by the addition of another chapter, this one treating of the radio-active gases produced by the disintegration of radium and radium-thorium, which have been added recently to the list of constituents of the atmosphere.

OUR ASTRONOMICAL COLUMN.

COMET 1906*c*.—From observations made on March 19, 20, and 21, Dr. Strömgren has computed the following elements and ephemeris for the comet discovered by Mr. Ross on March 18:—

Elements.

$$T = 1906 \text{ Feb. } 22{\cdot}216 \text{ Berlin M.T.}$$

$$\left.\begin{aligned} \omega &= 281^\circ\ 24'{\cdot}1 \\ \Omega &= 73^\circ\ \ 2'{\cdot}1 \\ i &= 80^\circ\ 34'{\cdot}0 \end{aligned}\right\} 1906{\cdot}0$$

$$\log q = 9{\cdot}88336$$

Ephemeris 12h. M.T. Berlin.

1906	α (h. m. s.)	δ (° ′)	log Δ	Brightness
Mar. 29	2 38 33	+ 4 11·5	0·2356	0·63
April 2	2 48 40	+ 7 38·4	0·2547	0·53
6	2 58 9	+10 47 5	0·2732	0·44

(*Kiel Circular*, No. 87.)

OBSERVATION OF COMET 1905*c* AFTER PERIHELION.—A letter received from Prof. H. R. Morgan (Glasgow, U.S.A.) by Prof. Pickering states that the former observed Giacobini's comet, 1905*c*, on February 21, that is, since it appeared to the east of the sun.

The comet's apparent position at 7h. 40m. 44s. (Glasgow M.T.) was α = 1h. 8m. 29·2s., $\delta = -11^\circ\ 9'\ 11''$, which gave corrections of −11s. and $-3'{\cdot}4$ to Herr Wedemeyer's ephemeris on the date of observation (*Astronomische Nachrichten*, No. 4079).

NEW VARIABLE STARS IN THE REGION ABOUT γ SAGITTÆ.—From the comparison of several photographs taken with the Bruce telescope, Prof. Wolf has discovered fifty-five new variable stars in the region about γ Sagittæ.

In No. 4079 of the *Astronomische Nachrichten* he gives the details concerning the discovery and measurement of each star, and, in addition, a list showing the position (1855·0) and the magnitude on various dates between 1900·7 and 1905·7. Forty-seven circular charts which accompany the paper show the region immediately surrounding each variable.

THE SUPPOSED NEBULOSITY AROUND NOVA AQUILÆ NO. 2.—In the opinion of Prof. Frost, the suggestion that the nebulous appearance of images of Nova Aquilæ No. 2 is entirely due to chromatic aberration is the correct one.

Plates taken with the 24-inch *reflector* at Yerkes Observatory on September 21 and 27, and October 23, 1905, show no nebulosity, whilst Prof. Wolf has obtained similar effects to this apparent nebulosity with other stars having peculiar spectra. A third argument against the phenomenon being due to true nebulosity is that, in order to produce the image obtained, the intrinsic brightness would have to be at least 1800 times as bright, in proportion to the light of the star, as that of the nebula known to exist around Nova Persei (*Astronomische Nachrichten*, No. 4079).

SOME TESTS OF THE SNOW TELESCOPE.—A very interesting note by Prof. Hale, published in No. 1, vol. xxiii., of the *Astrophysical Journal*, describes the present condition, and some tests, of the large Snow telescope which has been erected at the Solar Observatory, Mount Wilson.

The greatest inconvenience encountered in the early use of this instrument was in connection with the spectroheliograph work. Three mirrors are employed, of which the first, the 30-inch cœlostat mirror, reflects the solar rays on to a 24-inch plane mirror, which in turn directs the beam on to the 24-inch concave mirror of 60-feet focus, which forms the image of the sun on the primary slit.

When the instrument was used, with a high sun, on a hot, windless day, it was found that a serious change of focus, amounting in some cases to 12 inches, occurred, and, worse still, the mirrors became distorted, giving a difference of focus for the opposite limbs of the image of as much as 3 inches.

On days when a cool breeze blew across the surface of the mirror the change was less, so arrangements have now been made to send a current of air across the face of each mirror between the exposures, by means of fans.

Prof. Hale has found that an hour after sunrise is the best time for solar work, and after that an hour before sunset.

Experiments are being carried out for the purpose of discovering some good substitute for glass in mirror making. "Invar" has proved to be too soft, and the fused quartz discs have not been a success. Prof. Hale suggests that speculum metal will be found to answer the purpose better than glass.

Photographs taken with the Snow telescope have proved better than those obtained with the 40-inch refractor at Yerkes, and Prof. Hale states that, from a mechanical standpoint also, the telescope has proved completely successful.

STUDIES ON THE SYNTHESIS OF PEPTIDES AND PROTEIDS.[1]

AMONG the many brilliant achievements in synthetic chemistry accomplished by Prof. Emil Fischer during the last quarter of a century, none have surpassed in interest the remarkable series of researches which formed the subject of a recent address to the German Chemical Society.

In reading this address it is impossible to say which commands greater admiration, the author's consummate skill and endless resource in sweeping aside each difficulty as it arose in a most intricate field of experimental inquiry, or his intense and ceaseless activity in producing almost month by month during the past five years a wealth of new knowledge of the very first importance to biological science.

"Whilst our cautious colleagues," says Prof. Fischer, "fear that a systematic study of this group of compounds (the proteids) will be beset with endless difficulties on account of their troublesome physical features, there are others, among whom I count myself, who are more optimistic, and hold that an attempt at least ought to be made with every modern appliance to lay siege to this unconquered citadel; for it is only by a bold attempt that the limitations of our present methods can be adequately gauged."

The success which has so far attended Prof. Fischer's first attack promises a speedy capitulation. The proteids will then be made to deliver up the key to their molecular structure, and the first real advance in biochemistry will have been accomplished.

Although physiological chemistry has done much in the past in the way of classifying the numerous members of the proteid group, in preparing a few members in the crystalline form, in attaching to different individuals different biological functions, and in ascertaining the fundamental changes effected by ferment action, our knowledge of their chemical constitution has up to the present been extremely meagre. Apart from the percentage composition, it is limited mainly to the results of hydrolysis by acids, alkalis, or digestive ferments. When submitted to these agents all proteids yield successively albumoses, peptones, and, finally, amino-acids. Of the nature of the first two we are but little better informed than of that of the proteids themselves.

The study of the amino-acids has been attended with more success, for not only has the structure of the majority of them been ascertained, but many have been prepared synthetically. The following is a list of amino-acids obtained by hydrolysing one or other of the natural proteids:—

Glycine	Serine (α-amino-β-hydroxy-propionic acid)
Alanine	Tyrosine
Aminovaleric acid	Tryptophane (skatolamino-acetic acid)
Leucine	Lysine
Isoleucine	Arginine
Phenylalanine	Histidine
Glutamic acid	Diaminotrihydroxydodecanic acid
Aspartic acid	Diaminoglutaric acid
Cysteine	Diaminoadipic acid
α-Pyrrolidine carboxylic acid (proline)	Hydroxyaminosuccinic acid
Hydroxy-pyrrolidine carboxylic acid (oxypyroline)	Dihydroxyaminosuberic acid

[1] *Vide* Address by Prof. Emil Fischer, "Untersuchungen über Aminosäuren Polypeptide und Proteine" (*Berichte der deutschen Chem. Gesell.*, 1906, xxxix., 530.)

It was to the study of these acids—the fragments, so to speak, of the albumin molecule—that Fischer first directed his attention, hoping ultimately by piecing them together to construct the simplest of the albumins. In the synthesis of the monoamino-acids Fischer has added to the methods already known that of brominating the alkyl malonic esters and then converting the corresponding acid into the α-bromo-fatty acid, which with ammonia yields the amino-acid. He has, moreover, devised an ingenious process for resolving the synthetic, and, consequently, inactive compounds into their active components. The amino-acids are such weak acids that they refuse to form crystalline salts with the active alkaloids. By converting them into the benzoyl or formyl derivatives, strong acids are produced which may be easily resolved by the ordinary process of fractionally crystallising the salts of the active bases. The diamino-acids, such as ornithine (αδ-diaminovaleric acid) and lysine (αε-diaminocaproic acid), both common products (the former as arginine) of proteid hydrolysis, have also been synthesised by Fischer by adapting Gabriel's reaction in one case and that of Blank in the other. Gabriel's phthalimidopropylmalonic ester, when brominated, gives a monobromo-derivative, which is then hydrolysed and heated to remove one carboxyl group, the resulting compound being phthalimidobromovaleric acid,

$$C_6H_4\begin{matrix}CO\\CO\end{matrix}N.CH_2.CH_2.CH_2\,CHBr.COOH.$$

This was converted into the amino-derivative, and by splitting off the phthalyl radical the racemic form of natural ornithine was obtained,

$$NH_2.CH_2.CH_2.CH_2.CH(NH_2).COOH.$$

The starting point for the preparation of lysine was Blank's γ-cyanopropylmalonic ester,

$$CN.CH_2.CH_2.CH_2.CH(COOC_2H_5)_2,$$

which is converted by nitrous acid into α-oximino-δ-cyanovaleric ester,

$$CN.CH_2.CH_2.CH_2C(:NOH).COOC_2H_5.$$

The latter, on reduction, yields the racemic form of lysine (αε-diaminocaproic acid). The synthesis of hydroxyamino-acids such as serine of silk fibroin has also been accomplished by applying Strecker's reaction to the hydroxy-aldehydes. Thus ammonia converts the cyanhydrin of glycollic aldehyde into the aminocyanhydrin which on hydrolysis yields inactive serine,

$$CH_2(OH).CHO \longrightarrow CH_2(OH).CH(OH).CN \longrightarrow$$
$$CH_2(OH).CHNH_2.CN \longrightarrow CH_2(OH)\,CHNH_2.COOH.$$

Of no less importance to the solution of the albumin problem have been the new methods furnished by Fischer for the separation and identification of the products of proteid hydrolysis, for a correct knowledge of the varied compounds which compose the albumin molecule must necessarily precede any attempt to effect its synthesis. Foremost among these stands the "ester method." It consists in converting the mixture of amino-acids, obtained on hydrolysis, into the corresponding esters, which are then submitted to fractional distillation under very much reduced pressure (10–15 mm.). The method cannot, however, be conveniently applied to the separation of tyrosine or the diamino-acids, which are treated in a different fashion. Space does not permit of more than a passing reference to the formation of benzoyl, formyl, and β-naphthalene sulphonyl derivatives, and of the phenyl hydantoins obtained with phenylisocyanate, all of which have been utilised either in the purification or identification of the amino-acids. We must leave this part of the subject in order to follow Prof. Fischer into the more attractive field of constructive research, and examine the plans which he has laid for attacking the synthetic side of the problem. Simply stated, the object he has had in view has been to link together two, three, four, or more molecules of those amino-acids which the proteids yield on hydrolysis, and by varying the combinations to obtain eventually something resembling the peptones or the simplest albumins. To these artificial combinations of

amino-acids Fischer has given the name of *polypeptide*, or, according to the number of single amino-acid groups present, di-, tri-, tetra-, &c., peptide. This view of the constitution of proteid matter, which seemed at the outset of the investigation warranted by the nature of the evidence then forthcoming, received ample justification by the very recent isolation of the first natural dipeptide in the process of hydrolysing silk fibroin. But we are anticipating matters. The first of the polypeptides was obtained by Curtius in 1882, but as its structure is complex and has only been lately ascertained, we will begin with the simpler members prepared by Fischer.

In 1901 Fischer and Fourneau found that glycine anhydride, which, according to Curtius, is formed when glycine ester is heated in aqueous solution, is partly hydrolysed with mineral acids into glycylglycine, the first and simplest of the dipeptides,

$$NH\left\langle\begin{matrix}CH_2.CO\\CO.CH_2\end{matrix}\right\rangle NH + H_2O = NH_2.CH_2.CO.NH.CH_2.COOH.$$

A year later Fischer found that a third amino-acid or peptide group could be linked to the carbethoxy-derivative of glycylglycine (prepared by the action of chloroformic ester on the dipeptide) by heating it with leucine ester, whereby carbethoxyglycylglycyl-leucine ester resulted, which on hydrolysis is converted into the free acid,

$$C_2H_5CO_2.NH.CH_2.CO.NH.CH_2.CO.NH\ CH(C_4H_9)CO_2H.$$

The next year saw the introduction of a new method for adding fresh links to the peptide chain by the use of thionyl chloride. This effects the conversion of the end carboxyl group into the acid chloride, and it thus became possible by the subsequent action of an amino-ester to add a new peptide group to the molecule. Thus carbethoxyglycylglycine was converted successively into the acid chloride, and then by the action of glycine ester into carbethoxydiglycylglycine ester, and by a repetition of the process into carbethoxytriglycylglycine ester. Similar compounds with different amino-acids were obtained by this reaction. In all of them, however, the carbethoxy-group at the amino end of the chain refused to be removed, and a new method had to be found for preparing the free polypeptides. This was soon forthcoming. In 1903 Fischer and Otto introduced the chloracyl chlorides for the purpose. Glycylglycine ester was first combined with chloracetyl chloride, hydrolysed, and warmed with ammonia, whereby diglycylglycine was formed,

$$ClCH_2.COCl + NH_2.CH_2.CO,NH.CH_2.COOR = ClCH_2.CO,NH.CH_2.CO,NH.CH_2.COOR + HCl.$$

$$ClCH_2.CO,NH.CH_2.CO,NH.CH_2.COOH + NH_3 = NH_2\ CH_2.CO,NH.CH_2.CO,NH.CH_2COOH + HCl.$$

This method proved extremely fruitful, and led to the production of a variety of di-, tri-, tetra-, and penta-peptides.

It will be easily conceived how the methods just described afford the means of lengthening the peptide chain at either end. In the one case an α-chloro- or bromo-acyl chloride is added to the amino-group at one end, or, at the other, the carboxyl group is converted into the acid chloride, for which purpose thionyl chloride has since been replaced by phosphorus pentachloride dissolved in acetyl chloride. In the first case the action of ammonia, in the second that of an amino-acid or another peptide (the ester is not necessary) in presence of alkali, produces the new peptide. By combining the two processes, hexa- and hepta-peptides giving the biuret reaction have been formed from diglycylglycine, and Prof. Fischer confidently predicts the synthesis of still longer chains. In the present year Fischer has also found that two molecules of the methyl ester of diglycylglycine can by heating be combined into the ester of pentaglycylglycine, which yields the hexa-peptide on hydrolysis.

If the proteids themselves and the amino-acids to which they give rise comprised optically inactive members, the experimental difficulties in the way of synthesis might be looked upon as approaching solution; but few of the natural products are inactive, and the question of preparing by artificial means active polypeptides must be faced. This part of the problem has not been neglected. By resolving the amino-acids into their active constituents before linking them together, or by submitting certain inactive members to the selective fermentation of pancreatic juice (for trypsin acts upon some of the polypeptides as it does on proteids), active polypeptides have been obtained.

In addition to the action of trypsin, the polypeptides exhibit many characteristics of the simpler proteids; they are for the most part soluble in water; especially is this the case where the peptide is composed of different amino-acids; they are insoluble in alcohol, and many of the higher members give the "biuret" reaction. Like the proteids, also, they are quickly and completely hydrolysed by strong hydrochloric acid into amino-acids; the action of dilute hydrochloric acid and caustic alkalis is, on the other hand, very slow.

The concluding sections of the address will appeal more especially to physiologists, for they deal with the products of hydrolysis of the proteids themselves. Space will not permit of more than a passing reference to them; the reader who is interested in the products obtained by the action of pancreatic juice or the combined action of pepsin, hydrochloric acid, and pancreatin must refer to the original memoir. It may, however, be stated that pancreatin yields, in addition to numerous monoamino-acids, a product which does not give the biuret reaction, but shows a certain resemblance to the artificial polypeptides, and breaks up on hydrolysis with acids into alanine, leucine, glutamic and aspartic acid, as well as proline and phenylalanine. By the successive pepsin and pancreatin digestion the amount of this polypeptide body is diminished, but in its place proline and phenylalanine appear.

As many of the commoner forms of proteid matter behave in this way, Fischer concludes that proline is an actual constituent of the proteid molecule. For similar reasons he includes tyrosine, leucine, alanine, tryptophane, &c., which always appear in the pancreatic digestion of albumin, a view which is supported by the action of pancreatic juice on the artificial polypeptides containing these groups. But of all the facts which point to the polypeptide nature of the albumins, the most convincing is Fischer and Abderhalden's latest discovery of a dipeptide in silk fibroin, which they have identified as glycyl-*d*-alanine. The method of preparation is interesting, because it introduces the new principle of combining acid with pancreatic hydrolysis. The silk fibroin is first digested with 70 per cent. sulphuric acid for several days at 18°, then diluted with water, the acid removed with baryta, and the liquid evaporated and submitted to the action of pancreatic juice for eight days. The tyrosine which had then separated was removed, and the esters of the amino-acids were formed in the usual way and heated under reduced pressure at 65° to remove the alcohol and a little glycine and alanine ester.

From the syrupy residue dissolved in alcohol and saturated with ammonia gas (to convert the dipeptide ester into the diketopiperazine), a crystalline precipitate of glycyl alanine anhydride slowly separated. Fischer sees in this discovery a near prospect of obtaining the most important constituents of the natural peptones, and even of the albumoses, and of reproducing them artificially. "But the problem of reproducing true albumins," says Fischer, "is of far greater difficulty, for their reconstruction from the first products of hydrolysis (peptones and albumoses) will require entirely novel methods, and when these are found their application will probably be a laborious process. One may therefore ask the question whether the eventual success will compensate for the labour expended. This depends, in my opinion, on the profit which biological research can derive from it, and this, again, on the manner in which the synthesis has been accomplished. For such a synthesis may be compared to a tourist who rushes through a country in an express train and sees nothing. It is otherwise if the synthesis is constrained to advance slowly and to construct the molecule step by step. It is then like a traveller journeying on foot, who notes every feature of the road, and tries each side-path before the right one is found. He not only learns every inch of the country, but understands the nature of its inhabitants. He knows his way and can direct others. I can only look

upon it, therefore, as a piece of good fortune that synthesis demands the creation of countless new methods of construction, separation, and recognition, and the study of hundreds of intermediate products before the proteids themselves can be reached. For these methods not only serve in the end to produce all the natural albumins, but bring to light many more which may eventually serve to explain the remarkable changes which certain proteids effect in the form of ferments and toxins. J. B. C.

THE PROTECTION OF BIRDS.

IN its report for 1905, the Royal Society for the Protection of Birds directs attention to the circumstance that the year under review is the first during which it has enjoyed the privilege of a Royal Charter. Reference is also made to the importance of last year's ornithological congress in connection with the recognition of the great principle that bird-protection is an international affair, and that, in the case of migratory species, it is of little use to adopt protective measures in this country if indiscriminate slaughter is carried on abroad. It is, moreover, also pointed out that we are by no means free from reproach in this matter even at home, as is exemplified by the instance of a honey-buzzard which was killed and mounted in the Isle of Wight, although such procedure would have been illegal in Hampshire. The progress of bird-protection in India is referred to with approval; but it is stated that further international action is required in connection with the trade in "osprey-plumes."

Simultaneously with the report of the English Society for the Protection of Birds, we received those of the kindred American body, the National Association of Audubon Societies, for 1904 and 1905. The former of these contains a history of the "Audubon movement" in the United States by Mr. W. Datcher, the president of the association, and also the results of a special effort for the protection of water-birds, made possible by a fund at the disposal of the association. In the report for 1905 the president has to congratulate the association on its first year's working as a corporate organisation, the incorporation having largely augmented its power for good. After referring to the cordial relations existing between the association and foreign bodies the work of which is of a similar nature, the president directs special attention to correspondence relating to the urgent need of protection for the extensive bird-colonies in certain islands in the Pacific. Special efforts are being made to enlist the interest of the general public in bird-protection by means of exquisitely illustrated leaflets (of which we have received a sheaf) descriptive of some of the rare and more interesting birds. In the case of the cardinal and so-called American goldfinch, the illustrations are coloured.

THE PLACE OF POLYTECHNICS IN EDUCATION.[1]

THOSE of you who know what you are doing here and know what is being done in other places must feel that we are at a very interesting, almost a critical, time from an educational point of view. We may be said, indeed, to be at the beginning of a new renaissance—a new birth of learning, just in the same way that our forbears, A.D. 1000 up to A.D. 1200, were in the forefront of that first renaissance. But the trouble is that the dark ages did not cease then, for we have had a dark age since, and it is to correct this second dark age that this new birth is necessary. Now what did the inhabitants of Europe do at that first renaissance? They kept on the schools which had been brought down by the different rulers, the different church authorities, from the time of the Roman Empire. The Roman schools, judging from what the Romans did from Scotland to the south end of the Red Sea, must have dealt with the science of the time, and that perhaps is the reason that the earliest universities always included "the nature of things" in their curricula. A modern public schoolmaster might not think their education complete because Latin and Greek were the modern languages then, and the students were taught no dead ones; but, be this as it may, at the renaissance they insisted upon the teaching of Latin, because then everybody who was anybody spoke Latin—it was the *lingua franca* of Europe—and not to speak Latin was to belong to the corps of the deaf and dumb. Secondly, they had to learn Greek, because the movers in the educational world at that time were chiefly doctors, and they had learned all they could about doctoring and surgery from bad Latin translations of bad Arabic translations of the Greek authorities, so that when the Greek manuscripts became available all the world was agog to learn Greek in order chiefly that they might learn medicine and surgery. Now, I want to point out to you that in this we had education founded absolutely and completely upon the crying needs of the time. Very good. Then if we are going to do anything like that in our new renaissance, what ought we to do if we are to follow precedent? We must arrange our education in some way in relation to the crying needs of the time. The least little dip into the history of the old universities will prick the bubble of classical education as it is presented to us to-day. Latin was not learned because it had the most magnificent grammar of known languages. Greek was not learned in consequence of the transcendental sublimity of ancient Greek civilisation. Both these things were learned because people had to learn them to get their daily bread, either as theologians or doctors or lawyers, and while they learned them the "nature of things" was not forgotten.

Now what is the problem of to-day? We are in a world which has been entirely changed by the advent of modern science, modern nations, and modern industries, and it is therefore perfectly obvious that if we wish to do the best for our education it must be in some relation to those three great changes which have come on the world since the old days. Remember, in the old days there was no experimental philosophy, there was no steam, there was little relation practically between the ordinary lives of the people and the phenomena, or, at all events, the working of the world of nature around them. But with us all our life, the poorest life, the richest life, the country life, the town life, if it is to be lived properly and wholesomely, has to be lived in the full light of modern science; we have to know exactly the best thing to do and why we should do it. The problem before us to-day, if it be the same problem that was before those old peoples, the problem, that is to say, of learning everything we can from those around us in other nations, must drive us to the study of modern languages, just as the modern world conditions drive us to modern science, so that there, I think, we have an answer to those who may ask of us: What changes are you going to make in modern education if you are going to have the best possible education? First of all, we have the fact that we are bound, if we follow precedent, to deal with those things which are of importance from the present point of view. Latin is no longer the *lingua franca* of Europe, and we have better guides in science and philosophy than Aristotle. A question which arises when we go on to consider this matter is a very simple one: Is it worth while bothering about education? Is it worth while troubling to inquire what the old renaissance did or the new renaissance ought to do? Now there we approach a question in which the world is certainly very much wiser than it was a few years ago. Thirty or forty years ago, I am sorry to say, in this country practically nobody cared anything whatever about education, at all events about the education of the people, and the trouble with us now—the trouble that we shall have to take years to get over—is that in Germany that question was settled as early as the time of Luther, who insisted that it was the duty of all communities to look after the education of their children as well as the building of bridges and the making of roads. Now I think it is generally accepted, both in this country and in others, that whether the citizens of a State are educated or not is a matter of absolutely supreme importance, and when I say "educated" I mean educated morally and physically as well as intellectually. It is no longer merely the concern of the child or of the child's parent. It is acknowledged to be the only true foundation for a

[1] Extracts from an Address delivered at the Borough Polytechnic Institute on December 4, 1905, by Sir Norman Lockyer, K.C.B., F.R.S.

State's welfare and continued progress under conditions of peace or under conditions of war. We must face the applications of all the new sciences to every department of our much more complex national life, from the lowest employment to the highest fields of statecraft. If this is anything like true we have a great responsibility cast upon us when we talk about education. And when we inquire into the conditions we are still more impressed by this strenuous necessity of looking the facts in the face and seeing how this question affects us, not merely as being in this Borough Polytechnic, but as being Britons, as being members of a civilised community in the twentieth century. I have already said that even so far back as the time of Luther the Germans insisted that all their children should be educated; there should be no difference between the rich and the poor. What has grown out of that? The thing has gone on from strength to strength, until now in Germany, to deal with the Old World, we find a country with the greatest number of universities, with the greatest possible desire, from the Kaiser down to the peasant, to do everything for Germany that can be done by educating every child that is born in the country. What did democracy do when it had fair play in the United States of America? The first thing done was to apportion millions of acres for the future endowment of education. The acres did not mean much capitalised then, but they mean a great deal capitalised now; so that in the western States of America, where you get the purest voiced democracy that you can get, I think, on the surface of the planet, the children of the citizens, boys and girls, are educated from the age of six to the age of six-and-twenty without any call upon the parents or without any hesitation to carry as many as possible up to the very highest form of education. And when does the technical instruction come in there? The technical instruction is given only to those who have taken degrees in the university. Japan is following on the same lines. The educational system of Japan was started as near as may be at the same time that the new educational policy was begun here. The result of it has been that you have in Japan now a completely trained nation, trained to think, trained to do the best along any line that may turn up, and the difference between the existence of such a training and its opposite we have now in comparing the present condition of Japan with the present condition of China. Japan has become a world Power with whom we are proud to associate simply because the Japanese children have been taught to think and to do for thirty years. That is one of the most blessed things to think of, because it shows that if any nation, even the British nation, ultimately finds that it is backward, some thirty years, or perhaps even twenty years, spent in Japanese fashion may put everything right. But if that is so, then it is my duty to point out to you that we have a great deal to do. I have said that our present system of education was commenced, roughly, some thirty years ago, when the Japanese system was started, but at present our system deals only with primary and secondary education. It is a most extraordinary thing that our Minister of Education has not anything to do with the most important part of education. It is a situation truly British. Well, if we find that it is necessary to imitate the action of other States in having a department which shall include the top of education as well as the bottom, it is right that I should tell you at once that this will cost a great deal of money above what we spend at present. If we take one German university, Berlin—the equivalent of the University of London—the German State spends on it the sum of 169,000*l*. a year. That is to say, it spent that sum in the year 1891–2; whereas for our higher educational institutions—all the universities and university colleges in England, Ireland, Scotland, and Wales—until quite recently, the British Government allowed a smaller sum. That, I suppose, perhaps may be considered a fair estimate of the importance of education in the eyes of the British Government and in the eyes of the German Government. The worst of all this is that it is not merely a question of money and increasing taxation; it is a question of the hampering of all the industries of the country from top to bottom, from John O'Groat's to Land's End. In an official document published by the United States Government some four years ago, it was stated, as a result of considerable inquiry, that, taking the day students in the United States, in those colleges and universities where only day students were considered, there were more teachers of science in the United States than there were students of science turned out from the English colleges. Now, if that or anything like it is true, do you think that in any continued competition along any line in connection with any industry in the United States and here, we are likely to come out top? It is absolutely impossible. Sir William Mather, more recently, has given us some information on this point. He spent four months in America looking up the technical colleges and the conditions relating to the education of the industrial classes. He found that ten years ago there were attending educational establishments, that is to say, universities and colleges, 32,000 day students; all these were taking a three years' course. To-day there are 65,000 students being educated at these same colleges, and he says the spirit of America is so completely aroused to the necessity of making science the basis of all industry, it does not matter whichever it is, however simple the undertaking, that the whole tendency and trend of thought and feeling is to educate large masses of their young men so that they may take their part, not only as managers, employers, and capitalists, but as foremen and chief workmen in their great industries; and he ends by saying that it is necessary that we should urge our Government, whether it be Liberal or Conservative, to take care that there should be sufficient expenditure provided to enable our young people throughout the length and breadth of the land to possess equal advantages to those of young people of Germany and America.

If it is right that there should be this education, conferring upon the nation these enormous advantages, in considering the thing from the point of view either of the child or the child's parent, should there be one State-aided education for the rich and another for the poor? That is to say, if education—the *best* education—is worth all that is claimed for it, should the State deliberately foster the artificial production of a breed of second-rates? How can every child have a fair chance? Some of the older ones among you may remember Kingsley's "Saint's Tragedy." I will just quote two verses, with a little alteration in one:—

> "The same piece of clay makes a tile,
>   A pitcher, a taw, or a brick;
> Dan Horace knew life—you may cut out a saint
>   Or a bench from the self-same stick.
>
> "We fall on our legs in this world,
>   Blind kittens tossed in neck and heels;
> 'Tis education that licks Nature's cubs into shape,
>   She's the mill-head if we are the wheels."

Surely, then, if we must not differentiate education, if we must not knowingly support second-rate education, our duty is to find the best. We come, then, to the problem which I have not the courage to bring before you now, because one might talk for a week about it, and I have only twenty minutes left, even if you will grant me as much as that.

What is the best education? It has taken the world a long time to find out what it already knows about it, but I doubt whether even now the world has quite got to the bottom of the problem. I think we may begin by saying that the best education should teach us to learn how to think, how to observe and how to use our hands, eyes and brain; how to exercise the body, how to become good and useful citizens, and—this is my own notion, perhaps you all will not agree with it—how to bear arms. If you have such an education as that going on all over the United Kingdom, my idea is that, whatever may happen to them afterwards, whether the children become archbishops or ploughmen, they would not be harmed by such an education, and, as a matter of fact, they could not have spent their time better. Now that is a very important thing to bear in mind, because there are systems of so-called education about which it could be shown in a moment that those who have been put under them might have spent their time very much better. We must discriminate really very much more carefully than is generally done between education, which I will define as the power of learning how to think, and instruction, which means

the accumulation of facts. Education may bring us into contact with doing things by which money may be earned, but that contact in education is used for mental training. Useful knowledge may easily become the bane of education. Instruction in doing things frankly pursued for the purpose of earning a living is generally not so imparted that the power of thinking properly is increased and the general training carried on further. If that is anything like true, we come to the important consideration that the best teaching must certainly include the teaching of doing things—we must not merely cultivate the memory—and, above all, we must not stuff useful knowledge or anything else into those young minds with which we have to deal. They are not Strassburg geese; and the more you attempt to stuff them the worse it will be. What we have to do is to train the mind as a delicate rapier, enabling it to do anything it has to do in the most perfect manner—to train the eye, the hands, the brain to face anything under the best possible conditions. The question here arises, What sort of a Code have we now for the education of the young?—this new Code—the Code for the year 1905 for elementary schools. Well, for myself, I thank God that we have such a document. It is an enormous improvement upon everything, upon anything, which has gone before it in our country. I remember some twenty years ago, when the only concession made to the new knowledge was that some candidate, if he liked, might say something of what he knew about the common pump; it hardly went further than the common pump, but the new Code goes very much further than the common pump, and you may even look at the stars if you like; you may even observe once or twice a year where the sun is or where the moon rises. Having this official education for the young, how are we to deal with it in relation to such an institution as yours? How are we to consider what should happen to the young minds of boys and girls going up that educational ladder which Huxley pictured to us some years ago—that educational ladder from the gutter to the university? In considering such a ladder as this, of course the end of the teaching, the end of the time spent, in the primary school constitutes the first rung at which the educational ladder may be left, and you have to consider the certain number of boys and girls unfortunately getting off the educational ladder when they leave the elementary school. The question arises, Must everybody when they leave the primary school, and that, I am thankful to say, at a gradually increasing age; when they have done with the official, with the complete education, must they have done with the instruction which will enable them better to earn their daily bread—the instruction which should, if possible, be placed before them, because really it is to tackle that instruction and to tackle the life connected with it that they have been taught to think? If you omit to give a higher education, or education combined with instruction, to your boys and girls after you have taught them to think, you have made a good deal of that education ridiculous. Your institute proves that it is much better to give instruction to the young in things that they have to do before you make them absolutely face the music in the real contact with the stern world of reality, which they will certainly have to face sooner or later. When you consider, therefore, the stepping-off places from the education ladder—I have just referred to the first—and the necessity of getting instruction, of putting instruction in the way of those who have to step off the educational ladder, the importance, the enormous importance, of such an institution as yours begins to force itself upon one. Take the child in an elementary school under the present regulations. Instead of going on to the secondary school and continuing still further up the educational ladder, it can go to a higher elementary school. That is a new idea in England, and it is a very admirable one. When you ask, Why does the child step off? you will find yourself confronted chiefly with the dearness of education in this country, and then with the supposed necessity for early employment.

With regard to those two questions, I would just like to tell you a little story. I had, some thirty years ago, to visit Holland on an official mission, and among others I saw the Minister of Public Instruction there, who was a great friend of Prof. Reike, to whom I was accredited, and he told me what they had been doing then in Holland for the last six or seven years; precisely this same thing that the Board of Education is now doing with regard to the higher elementary schools. The boys left the elementary schools generally at the age of fourteen, and the habit was for those little creatures to be sent at once to the offices and counting-houses of the merchants in Rotterdam and Amsterdam and other places to begin their work as clerks, and the Minister told me, with a twinkle in his eye, that these shops and counting-houses were most extraordinary places, because they were full of high stools. The Minister thought he could not proceed with this suggested change of the continuation school, which was called the higher town school, until he could get the sympathy of those various merchants, and he went round and asked them whether, if he could prepare boys up to the age of seventeen years, they would make a trial of them. They said they would. I visited Holland some four or five years after this had taken place, and the Minister told me that if I went to Rotterdam or Amsterdam I should no longer find any of those tall stools. He said:—"Seventeen-year-old boys are there, and they will have none others; the time for the use of the boy of fourteen in a merchant's office in Holland has passed away; the boys who begin to do their work after they have been taught to think up to seventeen are so much better." There is just another story touching another point I will say a word about later. The Minister was so interested with this, and was so satisfied and delighted at the satisfaction which those boys gave to their employers, that he thought he would go a step further. I should tell you that the boys who continued in school after fourteen up to the age of seventeen were chiefly taught science and Latin, and he was anxious to know what would happen in the case of a competition between these boys and those from the gymnasia, which are the equivalents of our higher grammar or public schools in this country. The boys from the gymnasia went, in the natural course, when they left the gymnasia, to the university. So he obtained permission from the Government to give the high town school boys an extra year. Now, what did they have to do in this extra year? They had learned Latin, and they had learned science from the age of fourteen in their continuation school; all they had to do was to learn Greek. It seemed an impossible thing for the town schoolboys to attempt to learn as much Greek in nine months, which was the school year, as the boys in the gymnasia, who had been accumulating during nine years their instruction in the gymnasia and the primary schools; but, as a matter of fact, when the test leaving examination came to be gone through, the boys from the higher town school romped in over the gymnasia boys. So you see my story shows that the university is not an absolutely prohibited thing if those who have to do with the boys and girls concerned are keen enough to take every advantage of every opportunity; and it shows also that employers of labour, at all events in other countries, and I expect in this, will see the advantage of getting supplied with clerks and other assistants who have been taught to think as opposed to getting their offices crowded with people who have still to learn how to think.

There are several other questions connected with the Huxley educational ladder. One is that in leaving each rung we have frankly to acknowledge that we have to face the music of the struggle for existence. Not every boy who enters a primary school can go, of course, to the university, can go perhaps higher than a secondary school; some will even fail to get to a secondary school, but what you have to consider, I think, generally in relation to institutions like this is that if there is to be any stepping off the ladder the change must be made in the best possible way. The present system of allowing these changes from rung to rung to take place by examination by outsiders is, I think, absolutely and completely indefensible. I would hold the teachers in every primary school absolutely responsible for saying that such and such of their students will benefit by secondary education and some of their students will not, and if that be done, then, in consequence of the recent action of the London County Council,

it seems to me that you will have a rapidly increasing number of the best English boys and girls going on with their pure education, certainly well into the secondary stage. In this way you will catch your potential Faradays. One of the delightful things I found in my inspection here with Mr. Millis was that in your instruction, frankly so called, you make it as educational as you can, so that those who come to you after the age of the primary school may, if they so choose, by taking advantage of one or other of your organisations, not only get an immense amount of absolutely needed instruction for various walks of life, but an education which will be practically as good as an education which could be got on the ordinary education ladder to enable them to enter the universities. The recent improvements in education are brought home to us by the fact that Huxley's ladder by itself no longer represents all the present possibilities. There are now platforms at the chief stepping-off places, and ladders from them also leading to the university for those who do not fear to climb. These platforms are technical schools and institutes, in which practical training in science laboratories and literature must both find place.

There is one word I should like to say with regard to your day school. It is called a "Technical Day School for Boys." I find that in the London County Council list, Appendix B, it is called a "secondary school." Now are you a secondary school? That is a point that I am not quite familiar with. What I understand is that under the new regulations a school to be a secondary school must make application to the Board of Education to be reckoned as such, and if it is accepted you have this enormous advantage, or will have very shortly, if you have not it now. Your students will have the right to go to the university by passing the leaving examination, which will ultimately be carried on by the teachers in the secondary school, or, at all events, with teachers associated with the secondary school. I think you will agree with me that the less any education in any locality is fettered by examination by outsiders the better for that education it will be. If you are a secondary school your students will be able, as a matter of course, to enter the new university. Thank God that in London, after centuries of the neglect of education, we have a university; we shall soon be as well off as a good many second-rate towns on the other side of the water have been for hundreds of years. I believe it is settled that your students can matriculate at the university, can become internal students without the bugbear of Latin, if you look upon Latin as a bugbear. Personally, I do not; if you have time to learn Latin, so much the better, but if the struggle for existence is so great that it is science or nothing with you, well, with science you can now enter the London University from a secondary school. You will then carry your local students right up to the second rung, some will go on to the university, and some will step off to your evening classes. Voltaire, talking about education, said :—"On étudie les livres en attendant qu'on étudie les hommes" ("We study books before we have a chance of studying men"). Well, we have got past that now; we not only study books, but we study things, but whether we study books or things our education will not be complete until we study men, that is to say, until we have varied occasions of mingling with others who are thinking about other things, so that we may exchange thoughts and ideas and sympathies with other students of different branches of knowledge. Now I want to point out what a magnificent opportunity you have here for that kind of collegiate education. You are practically a college, and I believe strongly that this collegiate life, as we may call it, this mixing with one's fellow men, is of the very highest quality, that it is the absolute essential of a complete course of education which should produce what is called character. And let me remind you that people are prepared to pay a great deal for character. I find, for instance, that Mr. Balfour not very long ago said the collective effect of our public school education on character could not be over-rated, but he thought the boys of seventeen or eighteen who are educated in them do not care a farthing about the world they live in except so far as it concerned the cricket field, the football field, or the river. You have the machinery to enable you to care a great deal about the world you live in, to know an immense deal about it, and you have also the machinery for this formation of character. Now I believe in the combination, and it is upon that ground I hope some future day to see a strong secondary school here. I believe it will be a very great boon to this part of London; in fact, I feel so strongly on this that I should say your enormous advantages would be wasted if you did not take some part in the general scheme of pure education, and that part is quite obvious; you have to make your day school one of the best secondary schools it is possible to imagine. I should have hesitated to give you my opinion on your proper place in education and the excellence of your teaching staff and laboratories if I had not had an opportunity of examining your institution, and, in concluding, I want again to thank Mr. Millis for his very great kindness in showing me over it the other day.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. R. S. LULL, associate professor of zoology at the Massachusetts Agricultural College, has been appointed assistant professor of vertebrate palæontology in Yale University, and associate curator of vertebrate palæontology in the Yale University (Peabody) Museum.

PROF. W. W. WATTS, F.R.S., who is leaving Birmingham to take up the professorship of geology at the Royal College of Science, was entertained by his geological friends in Birmingham on March 23. Prof. Charles Lapworth, F.R.S., who presided, referred to the many services which Prof. Watts had rendered to geological students. Prof. Watts, after acknowledging the presentation made by Mr. J. Whitehouse on behalf of the past and present students, said that he was going to a school which would be in healthy but friendly rivalry to the Birmingham school.

AMERICAN institutions for providing higher education continue to benefit from the generosity of wealthy American citizens. *Science* announces that Princeton University has been made the residuary legatee of the estate of Mrs. J. Thompson Swan, which is said to be worth about 60,000*l*. The late Mr. Edwin Gilbert, of Georgetown, Conn., has left 12,000*l*. for the model farm of the Connecticut Agricultural College. Harvard University has received a gift of 10,000*l*. from Mr. R. W. Sayles, of Norwich, Conn., to establish a fund, preferably for the acquisition, preparation, and maintenance of collections suitable for a geological museum.

THE Board of Education has issued a return showing the extent to which, and the manner in which, local authorities in England and Wales have applied funds to the purposes of technical education, and other forms of education other than elementary, during the year 1903–4. In consequence of the fact that the Education Act, 1902, was coming into operation throughout the year with which the report deals, and that advantage was taken of this fact to initiate a new series of returns of this form of expenditure, the year must be regarded from the statistical point of view as transitional in character. The volume is, in fact, divided into two parts, the first continuing for about half the total number of local authorities the former series of returns, and the second initiating the new series for the remainder. The consequence is that the volume provides no total of the figures dealing with the whole country, and in view of the incompatibility of the bases of the expenditure shown in the two parts, such totals would only be misleading.

THE 1906 issue of the "Register and Official Announcement" of the Clark University, Worcester, Massachusetts, has been received. Among other interesting information, it may be noticed that the University has several funds for the endowment of fellowships. A sum of 600*l*. is now available for junior and senior fellowships from the George F. Hoar fund of 20,000*l*., provided by the generosity of Mr. Carnegie. There are in addition a citizen's fund of 1000*l*., the income of which is to be used for the aid of "some one or more worthy native-born citizens of the city of Worcester

who may desire to avail themselves of the advantages of the institution," and the Field fund of 100*l.*, the income of which is "to provide for the minor needs of a scholar or fellow." These fellowships are intended for young men and women of promise who desire to pursue post-graduate studies in order to fit themselves for intellectual careers. In general, those intending to devote themselves to some special branch of learning are preferred to those directly fitting themselves for one of the "three learned professions."

AT the Convocation of the Calcutta University on March 3, the Vice-Chancellor, Sir Alexander Pedler, dealt with the work of the University during the period 1873–1905. He said that the number of schools sending up candidates to the matriculation examination of the University was three times greater at the end than at the beginning of the period. In the same interval the number of colleges in connection with the University increased from fifty-two to eighty-one, and the number of professors and lecturers in these colleges from 278 to 717. Sir Alexander Pedler went on to ask, Has the University in any way troubled itself to secure that this expansion has been accompanied by the provision of three or four times the number of equally well trained and experienced professors and teachers? Has the University ascertained that the new schools and colleges are equal in quality to those of older and more mature growth? Are three or four times as many well trained or well paid teachers at work in the colleges and schools as thirty years ago? Are there three times as many professors or teachers for the colleges, trained in all the modern developments of western learning and acquainted with all the most recent discoveries in science as there were thirty years ago? To all these questions he said a direct negative must be given. The Government, which in its colleges ought to take the lead in such matters, has allowed a reverse policy to go on, and while in 1873 in Bengal the number of European professors or Indian professors with European training in Government colleges was thirty-one, in 1905 the number had fallen to twenty-seven, while the number of Indian or Indian trained professors had increased from nineteen to sixty. In university work in European countries and in England, when the number of students under instruction in colleges is compared with the number of professors and lecturers in various subjects engaged in teaching them, it is found, Sir Alexander Pedler said, to be about ten students to each professor. In the case of American technical colleges, frequently the ratio works out at one professor to seven or eight students. At the Michigan University one professor for every six students is found, and also at the Toronto University. Turning to the case of India, in the arts sections of certain colleges affiliated to the Calcutta University, for every professor there are such numbers of students as fifty-three or forty-six, and other similar numbers, or from five to nine times as many students as in other countries.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 18.—"A Study of the Mechanism of Carbon Assimilation in Green Plants." By Francis L. **Usher** and J. H. **Priestley**. Communicated by Prof. W. M. Travers, F.R.S.

(1) The photolysis of carbon dioxide may take place outside the plant in absence of chlorophyll, provided one of the products is removed.

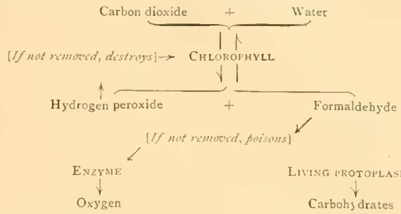
(2) The normal products of the photolysis are hydrogen peroxide and formaldehyde, though under certain conditions formic acid may be formed.

(3) In the plant the decomposition of the hydrogen peroxide is provided for by a catalysing enzyme of general occurrence.

(4) The condensation of the formaldehyde is dependent on the healthy condition of the protoplasm.

There are therefore three factors essential to photosynthesis from carbon dioxide and water in the plant; they are (1) vitality of the protoplasm, (2) presence of a catalysing enzyme, and (3) presence of chlorophyll. If any one of these factors be interfered with, the process of photosynthesis ultimately comes to an end, through the destruction of the optical sensitiser, chlorophyll.

The relations between the various factors in this process may be diagrammatically expressed thus:—



Society of Chemical Industry, March 5.—Mr. A. G. Salamon in the chair.—The ignition of nitro-compound explosives in small arm cartridges: W. D. **Borland**. The action of the igniter, *i.e.* the percussion cap, is to eject through the fire holes of the case a mixture of solid and gaseous products at temperatures between 2400° C. and 3200° C. in such quantity, volume, and time that the initial resistance of the bullet or shot is overcome before the bulk of the charge of powder develops its full energy, but without any hesitation which may upset alignment or perceptible "hang-fire." The rapidity with which these gaseous and solid matters are applied to the powder is determined by exploding the percussion cap in a hollow steel cylinder provided with a hardened steel plunger and resting upon a crusher lead. The proportion which the crushing pressure bears to total energy is found in practice to be a trustworthy guide to the rapidity with which the heat of the igniter is applied to the explosive, and consequently to the ratio which chamber pressures in the small arm bear to observed velocity of projectile. The volume of the gaseous matters in relation to the surface of the explosive can be readily determined. These must be large enough to ensure sufficiently high chamber pressures being set up for the most efficient combustion of the powder. The temperature of ignition was determined by radiation methods of observation, the cap being exploded into a glass tube and the radiation intensity of the solids observed by comparison with a radiant of known intensity, the portion of the spectrum chosen being in the neighbourhood of 6563 wave-length. The paper includes tables illustrating the action of different igniters on different explosives, both sporting and military, and tracing the effect of total heat energy and temperature of igniter upon velocity, pressure, and rapidity of ignition observed in ballistic trials.

Zoological Society, March 6.—Mr. C. S. Tomes, F.R.S., vice-president, in the chair.—A specimen of *Rana goliath*, obtained by Mr. G. L. Bates at Efulen, in South Cameroon: G. A. **Boulenger**. This frog measured 10 inches from snout to vent, and was much larger than any frog hitherto known.—"Flying" snakes: R. **Shelford**. The power of "flying" has been recorded by natives to be possessed by three species of snakes in Borneo, viz. *Chrysopelea ornata*, *C. chrysochlora* (Opisthoglypha), and *Dendrophis pictus* (Aglypha). All three species have the ventral scales with a suture or hinge-line on each side; by means of a muscular contraction these scales can be drawn inwards, so that the whole ventral surface of the snake becomes quite concave, and the snake itself may be compared to a rod of bamboo bisected longitudinally. By experiments on *C. ornata* it was seen that the snake when falling from a height descended, not in writhing coils, but with the body held stiff and rigid, and that the line of the fall was at an angle to a straight line from the point of departure to the ground. It is highly probable that the concave ventral surface of the snake helps to buoy it up in its fall; it can readily be shown that a longitudinally bisected rod of bamboo falls more slowly than an undivided rod of equal weight.—A series of reports on the zoological

results of the third Tanganyika expedition conducted by Mr. W. A. Cunnington in 1904–5 was read. Report on the fishes: G. A. **Boulenger.** The collection consisted of 300 specimens referable to eighty-four species, twenty-eight of which were new.—Crustacea: Dr. W. T. **Calman.** In addition to the two species already known from Lake Tanganyika, no fewer than ten specimens of new species belonging to the family Atyidæ, including the representatives of two new genera, were obtained. From lakes Nyasa and Victoria Nyanza only a single species was obtained, the widely distributed *Caridina nilotica* (*C. wyckii*). The absence of this common species from the gatherings made in Tanganyika emphasised the isolated character of the Macruran fauna of that lake. All the species found in Tanganyika, and all but one of the genera, were peculiar to the lake. There was no ground for regarding the Macrura of Tanganyika as having any specially "marine" affinities. The other members of the groups to which they belonged, the genus Palæmon and the family Atyidæ, were characteristically, and all but exclusively, fresh-water animals.—Mollusca: E. A. **Smith.** This collection contained examples of thirty-three species, one of which was new.—Fresh-water sponges obtained from lakes Victoria Nyanza, Tanganyika, and Nyasa: R. **Kirkpatrick.** The collection comprised eleven specimens representing five species, one from Tanganyika being new to science, two others from Tanganyika (*Spongilla moorei*, Evans, and *S. tanganyikae*, Evans) having already been recorded from that locality. Small specimens of a fourth species, viz. *Spongilla carteri*, Bowerbank, were obtained from the Victoria Nyanza, and a fairly large specimen of a fifth, viz. *Spongilla biseriata*, Weltner, was collected in a swamp bordering Lake Nyasa. Included in Mr. Kirkpatrick's report were descriptions of two new species and a new variety of fresh-water sponges, based on material obtained from the White Nile.—Oligochæte worms: F. E. **Beddard.** They comprised examples of four new species.—The medusæ of the genus Limnocnida obtained during the expedition: R. T. **Günther.**

Geological Society, March 7.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The occurrence of limestone of the Lower Carboniferous series in the Cannock-Chase portion of the South Staffordshire Coalfield: G. M. **Cockin.** Silurian limestone underlies the Coal-measures in the southern part of the South Staffordshire Coalfield, and a rock, probably similar, was found in a borehole at Cannock-Chase Colliery. A shaft was sunk some thirty years ago north of the latter locality, but was abandoned. In the waste-heaps, which have remained undisturbed since 1875, a number of fossils belonging to the Lower Carboniferous Limestone have been found. A fault must be presumed to bring Carboniferous Limestone into the position indicated. An account of the strata pierced by boring is appended.—Liassic Dentaliidæ: L. **Richardson.** Among the fossils collected in the cuttings on the new Honeybourne and Cheltenham Railway were many belonging to the family Dentaliidæ, and, as the majority are new, the author has investigated the Liassic members of the family contained in several collections. The growth of the scaphopod-shell is effected by additions at the anterior end, while the posterior end suffers by wear and absorption. The members of this class are essentially marine, inhabiting deep water, and feeding principally on Foraminifera. Eight new species are described, and eight species already known are discussed.

Entomological Society, March 7.—Mr. F. Merrifield, president, in the chair.—Two specimens of *Microdon latifrons*, Lw., a rare dipteron taken in the New Forest in June, 1905: H. W. **Andrews.**—Examples of *Nonagria neurica*, Hb., and *N. dissoluta*, var. *arundineta*, Schmidt, from Germany, with (?) var. *arundineta* from Central Asia, for comparison with *N. dissoluta* and *N.* var. *arundineta* from Kent, Cambridge, and Norfolk: H. M. **Edelsten.**—A variable series of *Gynopteryx gladiaria*, Guen., and its varieties: L. B. **Prout.**—Combs of the honey bee formed on a branch of nut tree, the bees having swarmed late in the year: A. J. **Chitty.** After July the bees deserted the combs, and, having consumed all the honey contained in them, again swarmed on a neighbouring tree.—A specimen of *Prodenia littoralis*, Boisd., which had emerged in a breeding-cage kept, with many others, by Major R. B. Robertson at Boscombe, Hants, for the reception of caterpillars found in that district: Prof. R. **Meldola.** The moth emerged on July 16, 1905. The species, which is figured in Hampson's "Moths of India," is said to have a distribution extending from the Mediterranean subregion throughout the tropical and subtropical zones of the Old World.—A Mantis on a portion of the bark of a tree found by Mr. F. Birch in Trinidad, who stated that its close resemblance to a withered leaf was evidently a protection for aggressive purposes: O. E. **Janson.**—A series of Callimenidæ; a small family of Orthoptera, consisting of two genera, Dinarchus, with the single species *D. dasypus*, Illig., and Callimenus, of which all the known species were included, with the exception of *C. inflatus*, Br., from Asia Minor: M. **Burr.**—Specimens of *Argynnis niobe*, var. *eris*, ♀, from the Pyrenees, Cevennes, and south Tyrolese mountains: H. **Rowland-Brown.** Attention was directed to the remarkable form of the example taken at Gavarnie, in July, 1905, of which the coloration of the upper side of all the wings was ruddy copper-red shot with blue upon the nervures. Whereas specimens of *eris* and other Argynnids from the mountainous regions of central France showed a tendency to maintain constant pale forms, those from the Pyrenees are generally more highly coloured, while the high Alpine forms of Central Europe inclined to melanism.—An original note-book of Burchell's taken to South Africa in 1812: Prof. E. B. **Poulton.** The note-book established the date of the author's birthday, hitherto unknown, to be July 12, while it also recorded, for the first time, the superstitious dread of the native Hottentots for the "death's head moth," known locally as the "devil bee."—Specimens of Pierine butterflies from South Africa, India, and Asia Minor: Dr. F. A. **Dixey.** The specimens illustrated how the under sides of the dry-season forms in the group are apt to take a red tinge, and it was especially interesting to note that the same tendency was manifest in all species collected from such widely separate regions.—Note on the migration of Lepidoptera against the wind, extracted from a report on "The Pearl Oyster of the Gulf of Manaar, *Avicula* (*meleagrina*) *fucata*," by Henry Sullivan Thomas, in the *Madras Journal of Literature and Science*: C. O. **Waterhouse.**—A plague of ants in the Observatory district, Cape Town, South Africa: Colonel C. T. **Bingham.**—Some rest attitudes in butterflies: Dr. G. B. **Longstaff.** The paper was illustrated by numerous specimens arranged upon backgrounds of specially prepared sand-paper approximating to the natural surroundings of the insects in their various habitats.—Observations on the life-history of *Trichoptilus paludum*, Zell.: Dr. T. A. **Chapman.**—Some parasitic hymenopterous insects of North Queensland: F. P. **Dodd.**

Physical Society, March 9.—Dr. C. Chree, vice-president, in the chair.—The velocities of the ions of alkali salt vapours at high temperatures: Prof. H. A. **Wilson.** This paper contains a summary of previous work. It is shown that all results so far obtained are consistent with the view that any salt of cæsium, rubidium, potassium, sodium, or lithium gives in a Bunsen flame negative ions having a velocity of 1000 cm. per sec. for one volt per cm., and positive ions having a velocity of about 80 cm. per sec. This result can be explained by supposing that each salt molecule emits a negative corpuscle which forms the negative ion, and that the rest of the molecule forms the positive ion.—Some experiments on earth-currents at Kew Observatory: Dr. J. A. **Harker.** An account of experiments made some years ago at Kew Observatory on the earth-currents produced by electric traction schemes, and on the disturbances they cause on the self-recording magnetic instruments kept continuously running to register the variations in the declination and the horizontal and vertical forces. Two large earth-plates were buried about 4 feet deep and 200 yards apart, and connected through a photographic recording voltmeter of high resistance. On the traces given, the effect of the trains on the Central London Railway was strikingly shown. The nearest point to Kew is about six miles distant. The same disturbances, and also those due to special traction experiments carried out on the system of the London United Electric Tramway

Company during the period when the Central London Railway was shut down, were also clearly shown on magnetograph curves. The effects are much greater on the vertical force than on the horizontal force or the declination. A second system of investigation was to connect the earth-plates through the primary of a transformer, the secondary terminals of which were connected to a sensitive moving-coil galvanometer of suitable period and damping. The galvanometer recorded a ballastic throw for each movement of a tramway controller, while the slower variations due to magnetic storms were without effect. A telephone similarly connected gave a perceptible sound for each controller movement.

Royal Meteorological Society, March 21.—Mr. R. Bentley, president, in the chair.—South Africa as seen by a meteorologist: Dr. H. R. **Mill.** The lecture was illustrated by a series of lantern-slides from photographs taken during the tour of the British Association in 1905. The places visited included Cape Town, Table Mountain, Durban, Maritzburg, Ladysmith, Johannesburg, Pretoria, Bloemfontein, Kimberley, Bulawayo, the Matoppo Hills, the Victoria Falls of the Zambesi, Salisbury, Umtali, and Beira. During the return journey, Mombasa, Cairo, and the Suez Canal were visited. Photographs were shown of meteorological stations in many of the places named, and the views of the scenery were selected to bring out the climatic features.

CAMBRIDGE.

Philosophical Society, February 12.—Mr. F. Darwin in the chair.—Notes on cycads: with exhibition of a rare species acquired by the Botanic Garden: A. C. **Seward.** The author exhibited a plant of *Cycas Micholitzii*, Dyer, recently obtained by the curator of the Botanic Garden from Messrs. Sanders and Sons. This species was discovered by one of Messrs. Sanders' collectors, Mr. W. Micholitz, in Annam, and described last year by Sir William Thiselton-Dyer in the *Gardeners' Chronicle*, August 19, 1905, p. 142. The author directed attention to the importance of cycads as representing scattered survivals from a remote past, and as plants which still retain traces of ancestral characters.—Respiration and vitality: F. F. **Blackman.**—Experiments on the hybridisation of barleys: R. H. **Biffen.** The behaviour of the more important differentiating characters to be found among the varieties of barley has been investigated.—A comparison of the results from the Falmouth declination and horizontal force magnetographs on quiet days in years of sun-spot maximum and minimum: Dr. **Chree.**

February 26.—Dr. Fenton, vice-president, in the chair.—An indicator for strong acids and bases: Dr. **Fenton.** Reference was made in previous communications by the author to a new condensation product, derived from methylfurfural, which has the molecular formula $C_{11}H_8O_4$. It was pointed out that this substance may have useful applications in organic analysis, since it gives highly characteristic colour-reactions with certain classes of compounds, such as amines and ureas. In the present paper it is shown that the reagent serves also as an indicator of alkalinity, and further, that by condensation with urea a colourless base is obtained which is turned blue with acids, and may therefore be used as an acid indicator.—The action of acid chlorides of acetylenic acids on ketonic compounds: S. **Ruhemann.** The paper gives an account of experiments undertaken with the view of supporting the constitution of the product of the reaction between phenylpropiolyl chloride and acetylacetone, and the formula of the substance formed from it under the influence of secondary bases. The properties of this substance have been found to resemble in every respect those of oxalyldibenzylketone.—The dihydrotetrazines: S. **Ruhemann.** The author has extended his research on tetrazoline, and found that the properties of dimethyltetrazoline differ most markedly from those of tetrazoline.—The velocity of transformation of sugars by alkalies: R. S. **Morrell** and A. E. **Bellars.** Aqueous solutions of glucosates, fructosates, and mannosates of guanidine, potash, and soda undergo slow change indicated by a decline in the rotatory power. The velocity of change, as measured by the diminution of the optical activity of the solutions, is that of a unimolecular reversible reaction. Under the conditions of the experiments glucose and fructose are mutually transformable, the production of mannose and acids proceeding at such a slow rate that glucose and fructose first attain an equilibrium, which is afterwards disturbed by the appearance of steadily increasing quantities of saccharinic acid. In the case of guanidine mannosate solutions, the velocity constant obtained from observations of the fall in rotatory power has nearly the same value as the corresponding one for guanidine glucosate and fructosate, but direct measurement of the rate of disappearance of the mannose gave a very much lower value.—The influence of very strong electromagnetic fields on the spark spectra of (*a*) vanadium, (*b*) platinum and iridium: J. E. **Purvis.** The field strength was 39 980 C.G.S. units. (1) With regard to vanadium, two lines become sextuplets and four lines become quintuplets. There are a number of lines divided into four, whilst the great majority of them become triplets. Also there are a few doublets, and there are about eight lines which do not appear to be affected. The distances of the separated constituents from the normal lines were measured, and the value of $d\lambda/\lambda^2$ calculated; and it is seen that many of the lines may be expressed by the same formula, the appearances of the undivided lines and the separated constituents and the values of $d\lambda/\lambda^2$ being essentially identical. (2) Similarly, with regard to the metals Pt and Ir, there are lines of both metals which may be grouped together as possessing identical $d\lambda/\lambda^2$ values, and the normal lines and separated constituents of which are similar in appearance. (3) In several instances the values of $d\lambda/\lambda^2$ for the several constituents seem to be simple multiples of each other.

PARIS.

Academy of Sciences, March 19.—M. H. Poincaré in the chair.—Observations of nebulæ: M. **Bigourdan.**—The distillation of titanium and the temperature of the sun: Henri **Moissan.** The boiling point of titanium is very high, and it was necessary to employ a current of 1000 amperes at 55 volts in the electric furnace to volatilise it readily. The distilled titanium was obtained on the cold tube mixed with lime, distilled from the furnace body. This lime was removed by acetic acid, and the residue was proved by its chemical properties to be titanium. Taking the temperature of the electric arc as 3500° C. (Violle), it is clear from the fact that titanium vapour exists in the sun that the temperature of the sun must be above 3000° C.—Benzyl- and phenylborneols and their products of dehydration: the benzyl- and phenyl-camphenes: A. **Haller** and E. **Bauer.** The secondary benzylborneol was prepared by the reduction of benzylcamphor, and its dehydration by phthalic anhydride; formic acid and pyruvic acid gave rise to the α-benzylcamphene. The tertiary benzylborneol was prepared by Grignard's reaction from camphor; its dehydration gave an isomeric β-benzylcamphene, the properties and derivatives of which are described.—The facies of variation of certain nepheline syenites from the Los Islands: A. **Lacroix.**—Gennadas, or bathypelagic Peneids: E. L. **Bouvier.**—The sheet of the Geological Survey, on the scale of 1 : 80,000, dealing with the region of Gap: Michel **Lévy.**—Functions which depend on other functions: Vito **Volterra.**—Observations of the Kopff comet (1906*b*) made with the bent equatorial of the Observatory of Lyons: J. **Guillaume.** The observations were made on March 5, 6, and 7. The comet appeared as a nebulous star of 15″ diameter and about 10·5 magnitude.—Observations of the comet 1906*b* made at the Observatory of Algiers with the 31·8 equatorial: MM. **Sy** and **Villatte.** Observations were made on March 5, 6, 7, and 8.—A new solution of the problem of magnetic induction for an isotropic sphere: Tommaso **Boggio.**—The resistance of emission of an antenna: C. **Tissot.** A discussion of the most favourable conditions for using a thermal indicator as a receiver of Hertzian waves.—The mechanism of the positive light: P. **Villard.** The positive column in a Geissler tube is regarded as a chain of gaseous particles traversed by the current. It still remains to be determined whether the emission of light is due to the passage of the current or to the progressive dislocation of the chain by the shock

of the negative ions.—Antimony and sulphide of antimony: MM. **Chrétien** and **Guinchant**.—The action of the amino-ethers and imino-chlorides on organo-magnesium derivatives: R. **Marquis**. An attempt at a new general method for the synthesis of ketones, starting with the imino-ether R.C(OR):(NR). The yield in the case of benzophenone is good, but the method is not general. In some cases the imino-chloride gives better results.—The preparation of glycidic ethers and of aldehydes in the hexahydroaromatic series: Georges **Darzens** and P. **Lefébure**. The glycidic esters were obtained by the interaction of chloracetic ester with cyclohexanone in the presence of sodium ethylate. The aldehyde is prepared from the glycidic ester by heating in a vacuum. The reaction has been applied successfully to homologues of cyclohexanone.—The structure and probable origin of the magnetic iron ore of Diélette, Manche: L. **Cayeux**. Conclusions as to the mode of formation of the ore are drawn from a micrographic study.—The gasteropods collected by the Charcot Antarctic Expedition: A. **Vayssière**.—The structure of the sporal wall of the Myxosporidia: L. **Léger** and E. **Hesse**.—A genus of lamellibranchs with multiple mouths: Paul **Pelseneer**. The genus Lima is characterised in its normal condition by having two symmetrical buccal orifices, each of which leads directly into the œsophagus.—X-rays and genital activity: F. **Villemin**.—The disease of wine (Graisse): E. **Kayser** and E. **Manceau**.—The toxin and antitoxin of cholera: MM. **Brau** and **Denier**. The serum of animals which have received the toxin under the skin possesses very slight antitoxic power. The antitoxic power of the serum becomes much more marked when the toxin has been injected into the veins.—The laws of muscular elasticity and their application to energetics: Charles **Henry**.—Some new palæontological data on the Devonian of western Ahenet, Central Sahara (expedition of MM. R. Chudeau and E. F. Gautier): Emile **Haug**.—The fauna of the Lower Coal-measures of Baudour (Hainaut): J. **Cornet**.—The flora of the same: Armand **Renier**.—Chalk and clay on the sea floor: J. **Thoulet**.

DIARY OF SOCIETIES.

THURSDAY, MARCH 29.

ROYAL SOCIETY, at 4.30.—On the Dilatational Stability of the Earth: Lord Rayleigh, O.M., P.R.S.—On the Observations of Stars made in some British Stone Circles. Second Note: Sir J. Norman Lockyer, K.C.B., F.R.S.—The Calculation of Ellipsoidal Harmonics: Sir William D. Niven, K.C.B., F.R.S.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company: C. P. Sparks.—Electric Winding, considered Practically and Commercially: W. C. Mountain.

FRIDAY, MARCH 30.

ROYAL INSTITUTION, at 9.—Recent Progress in Magneto-optics: Prof. P. Zeeman.

SATURDAY, MARCH 31.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

MONDAY, APRIL 2.

SOCIETY OF ARTS at 8.—Fire, Fire Risks, and Fire Extinction: Prof. Vivian B. Lewes.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Ropiness in Flour and Bread, and its detection and Prevention: E. J. Watkins.—The Röse-Herzfeld and Sulphuric Acid Methods for the Determination of the Higher Alcohols.—A Criticism: V. H. Veley, F.R.S.

TUESDAY, APRIL 3.

ROYAL INSTITUTION, at 5.—The Influence of Geology on Scenery: Dr. J. E. Marr, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Harbours of South Africa: C. W. Methven.—*Probable Paper*: On the Resistance of Iron and Steel to Reversals of Direct Stress: Dr. T. E. Stanton and L. Bairstow.

WEDNESDAY, APRIL 4.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Variations in Direction o the Wind, and an Instrument for determining them Graphically: B. F. Beverley.

GEOLOGICAL SOCIETY, at 8.—On a Case of Unconformity and Thrust in the Coal-measures of Northumberland: Prof. G. A. L. Lebour and Dr. J. A. Smythe.—The Carboniferous Succession below the Coal-measures in North Shropshire, Denbighshire, and Flintshire: Dr. Wheelton Hind and J. T. Stobbs.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.

SOCIETY OF ARTS, at 8.—Ramie and its Possibilities: Mrs. Ernest Hart.

THURSDAY, APRIL 5.

ROYAL SOCIETY, at 4.30.—*Probable Paper*: On the Physiological Action of a Recently Discovered African Arrow Poison: Dr. Charles Bolton.

CHEMICAL SOCIETY, at 8.30.—An Improved Apparatus for measuring Magnetic Rotations and obtaining a Powerful Sodium Light: W. H. Perkin, Sen.—The Rusting of Iron: G. T. Moody.—On the Determination of Carbon in Soils: A. D. Hall, N. H. J. Miller and N. Harmer.—The Electrolysis of the Salts of $\beta\beta$-Dimethylglutaric Acid: J. Walker and J. K. Wood.—Bromo- and Hydroxy-Derivatives of $\beta\beta\beta'\beta'$-Tetramethylsuberic Acid: J. K. Wood.—Some new Orthoxylene Derivatives: G. Stallard.—A new Solvent for Gold. Preliminary Note: J. Moir.—The Molecular Condition in Solution of Ferrous Oxalate: a Correction: S. E. Sheppard and C. E. K. Mees.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain (*Conclusion of Discussion*).

LINNEAN SOCIETY, at 8.—*Exhibition*: Some Plants new to the Pre-Glacial Flora of Great Britain: Clement Reid, F.R.S.—*Papers*: A Second Contribution to the Flora of Africa.—Rubiaceæ and Compositæ, Part II.: Spencer Moore.—The Anatomy of the Stem and Leaf of *Nuytsia floribunda*, R.Br.: E. J. Schwartz.—Taiwanites, a new Genus of Coniferæ from the Island of Formosa: B. Hayata.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Steam Turbines: G. D'A. Meynell.

FRIDAY, APRIL 6.

MALACOLOGICAL SOCIETY, at 8.—On a Species of the Land Molluscan Genus Dyakia from Siam: Lt.-Col. H. H. Godwin-Austen, F.R.S.—Descriptions of new Species of Land Shells from Peru and Colombia: S. I. Da Costa.—Note on Swainson's Genus Volutilithes: R. Bullen Newton.—Further Notes on the Genus Chloritis, with Description of new Species: G. K. Gude.—*Vertigo parcedentata*, Braun, in Holocene Deposits in Great Britain: A. S. Kennard and B. B. Woodward.

ROYAL INSTITUTION, at 9.—The Physical Basis of Life: W. B. Hardy, F.R.S.

SATURDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Salt-making in Essex, Ancient and Modern: Miller Christy.—Neolithic Man in Epping Forest. F. W. and H. Campion.

CONTENTS.

THURSDAY, APRIL 5, 1906.

IONS, ELECTRONS, AND CORPUSCLES.

Les Quantités élementaires d'Électricité: Ions, Électrons, Corpuscles. Mémoires réunis et publiés par Henri Abraham et Paul Langevin. Two volumes. Pp. xvi+1138. (Paris: Gauthier-Villars et Fils, 1905.) Price 35 francs.

THIS very important work, which has been brought out by the French Physical Society under the joint editorship of MM. Abraham and Langevin, consists of a series of digests of the memoirs on which the foundation of the electrodynamic theory of matter is laid. In some cases *résumés* of their researches have been written especially for this work by the original authors, but in the majority of instances the papers have been dealt with by abstractors. The value of this method depends entirely on the insight which is brought to bear upon it, and the task must have been particularly difficult in the present instance owing to the great variety of the material concerned, since many of the investigations are purely experimental, whilst others require all the skill in abstract reasoning possessed by the pure mathematician. The excellence which we should expect from the names of the editors, one of whom, M. Langevin, has himself made extensive and valuable contributions to the subject, is completely justified by the result. Whenever it was consistent with the necessary brevity, the abstractors have kept to the original words of the author, and, so far as the reviewer has been able to discover, no author can claim that his views have been misrepresented in any important particular.

The book will be heartily welcomed by all who are interested in the development of the electron theory, whether it be in its most general aspect as a fundamental theory of physical phenomena or in its extremely interesting applications to such complex branches of the subject as the conduction of electricity through gases and radio-activity. It is true that we have a number of books, such as J. J. Thomson's "Conduction of Electricity through Gases" and "Electricity and Matter," Larmor's "Æther and Matter," Poincaré's "Électricité et Optique," Stark's "Die Electrizität in Gasen," and Rutherford's "Radio-activity," which in one way or another contain the whole of the material of the two volumes under review; but in these cases the material has usually been selected, often, of course, with gain of interest, so as to emphasise the point of view of the particular author. In the present work, on the contrary, we are furnished with an account of each portion of the subject as it developed itself in the mind of its discoverer. The work therefore fills a distinct lacuna in the literature of the subject.

Recent advances in electrodynamics have placed the fundamental principles of physics in an interesting but not altogether satisfactory position. By considering the energy of the electric field, J. J. Thomson showed, many years ago, that a moving electric charge possessed a spurious mass due to the disturbance it created in the ether through which it was moving. This idea has been more than confirmed by the experiments of Kaufmann on the mass of the Becquerel rays or negative electrons. These experiments show that the *whole* of the mass of these electrons is of electrical origin, and is due entirely to the motion of their electric charges. The work of Lorentz and Larmor has given very good reasons for supposing that all matter consists solely of electrons, so that we are forced to the conclusion that the mass of all matter is due to the electrical charges of its ultimate particles.

The reasoning by which this result has been arrived at is dynamical in character, and is therefore based on mass, space, and time as fundamental conceptions. Thus, by the application of a system of thought in which mass is a fundamental conception, we have succeeded in resolving the idea of mass into something, viz. electricity, which lies outside the system.

There appear to be two ways of escape from the confusion implied by this paradoxical result. The first is to resolve electricity into the mass motion of a mechanical ether, and thus to make everything again consistent with the fundamental laws of mechanics. Attempts to construct a dynamical theory of the ether have continually been made ever since the ether began to figure in the literature of exact science. The most successful hitherto has been that of Larmor, which made the ether a perfect fluid composed of gyrostatic atoms. According to this view, which has been criticised by Poincaré in his "Électricité et Optique," the velocity of the ether is along the lines of magnetic force. We have, however, good grounds for thinking that the drift velocity of the ether is proportional to the vector product of the electric and magnetic forces, and it is probable that the successful ether theory will furnish an explanation of this result.

The second way of escape is to take the equations of the electromagnetic field as ultimate relations which are empirically given and of which there is no "explanation." By making energy the fundamental conception, we could then obtain a consistent scheme which would not involve the idea of mass in any fundamental way. The equations of motion of any material system could then be obtained by an appropriate variation of the energy function, which of course contains only electric and magnetic terms, and the results expressed in terms of force subsequently if required. On this view the momentum in any system is obtained as the volume integral of the vector product of the electric and magnetic forces, and mass is simply the vector coefficient which results on dividing the increase in this by the corresponding increase in velocity. This method of stating the case, which makes mass a very secondary conception, will at once be recognised as our old friend the "energetic" view of things, and the electrodynamic explanation of mass may justly be regarded as a great triumph for energetics. The considerations which have been brought forward in the preceding paragraph show, however, that the solution in terms of

A A

energy is not the only solution of the problem, and it remains for the future to decide which of the two is the more convenient and the more fundamental. The "energetic" system of physical philosophy suffers by being intangible and lacking in imaginative stimulus, whilst the material it makes use of in order to build up a picture of the phenomena of nature is not characterised by the simplicity which is desirable in relations of so ultimate a character.

Returning to the book under review, we find, naturally, that a great deal of it refers to the important investigations on the charge, mass, velocity, and other properties of ions and electrons. These have been described with that excellence which characterises the whole production. The reader will find a particularly satisfactory account of Townsend's very exact investigations on ionisation by collisions.

There is a minor point which may be criticised, and that is the prominence given to Moreau's results on the velocity of ions produced by metallic salts in flames. That investigator found that the velocity of the negative ions varied in an unexplained way with the concentration of the salt and the atomic weight of the metal, whereas H. A. Wilson found it to be independent of both these factors. The editors appear to have overlooked the experiments on this subject of the last-named author.

With this slight exception, we have nothing but praise for the whole work, and heartily congratulate the French Physical Society and all who have been concerned in its production. We hope that they will be able to bring out more volumes of a like kind as the development of the subject proceeds. It will be remembered that a few years ago the French Physical Society published a very important series of memoirs, on all branches of physics, which had been communicated to the International Congress at Paris in 1900. The extraordinary activity of the society in this way must command the admiration and gratitude of physicists in every part of the world.

O. W. Richardson.

ANOTHER PLEA FOR RATIONAL EDUCATION.

On Professional Education, with Special Reference to Medicine. An Address delivered at King's College, London, on October 3, 1905. By Prof. T. Clifford Allbutt, F.R.S. Pp. vi+80. (London: Macmillan and Co., Ltd., 1906.) Price 2s. net.

"THERE is no state so perilous as that in which things seem good to us, and at present in England the schoolmaster is complacent, the public indifferent." So Prof. Allbutt generalises early in his address, directing attention, however, in a footnote, to a single exception in the case of the headmaster of the Perse School, Cambridge. Though many more earnest schoolmasters anxious to reform scholastic methods could be named, thoughtful observers of English educational procedure must admit—in spite of the current bickerings among politicians as to religious instruction in elementary schools—that the schoolmaster's policy of *laisser-aller* and the apathy of the public are, and have been, the chief causes of the chaotic and rudimentary state of our secondary education. For half a century it has been dinned into the ears of statesmen, parents, and schoolmasters that no system of higher education, whether academic or technical, can prove successful in the absence of a sane, modern, and broad supply of secondary education given by rationally trained teachers. Prof. Allbutt is to be congratulated upon ranging himself on the side of the prophets, and though for the present he may be a voice crying in the wilderness, his able advocacy of the introduction of sweet reasonableness into our secondary schools will some day be counted unto him for righteousness.

A few of Prof. Allbutt's lessons to the schoolmaster may be quoted with advantage. "The scientific study of facts is the lever by which liberal culture has been re-awakened, and we are beginning to see that the ideas and methods of natural science, instead of being merely curious or commercial, are, if not the flower of education, at any rate the stem and branches." "On both 'sides' [of most schools], while the memory is exercised, and the intellect somewhat called upon, the imagination, the centre of creative life, the source of great action, is left out in the cold." The teacher who fears the baneful effects of specialisation may note this:—"I am satisfied that if the two main coefficients of mind—the intellect and the imagination—are fostered, it proves best in the end to promote development in each person on the lines of his own nature." But we have kept what in our judgment is the most important quotation—trite though the advice is—to the last:—"It is not so much *what* a man is taught as *how* he is taught it."

This advice leads naturally to the consideration of the present secondary school curriculum. Not every essential part of a wide subject can be included in a single address, but it is to be regretted that Prof. Allbutt has so little to say on the simplification and lightening of the absurdly congested time-tables of most schools. It is true that we are told that the current teaching of Greek and Latin is a parody of education, and that, like Sir William Ramsay, Dr. Allbutt considers chemistry is not a good subject for boys, but some guidance in the direction of a ruthless cutting down of the number of subjects at present studied by young boys would have been welcome. It is in this direction that the schoolmaster has a right to look to the man of science for guidance. Cannot physiologists and psychologists agree together as to what groups of faculties should be trained during the years of school-life, and, with the help of pedagogical experts, decide which groups of subjects best assist such training? Until this is done, or until some masterful genius filled with the pedagogic passion arises who will solve this most pressing of educational problems, secondary education will continue to be a process of filling the minds of boys and girls with pellets of information in a multitude of subjects, and of loading the verbal memory with a brecciated congeries of unrelated facts.

On the tertiary, or university, stage of education

Prof. Allbutt speaks with authority and full knowledge. He points out to the medical student who through comparative indigence has to proceed from the secondary to the medical school without the initiatory university course with which his more opulent contemporary is favoured, that "there is no difficulty, at any rate in university education, in using for general training the broader principles of any one of the professional faculties." Applying his principle already quoted, that it is not what is taught but how it is taught, Dr. Allbutt shows how professional studies may be made sources of culture and broad ideas by the non-university medical student. But there is in no sense a disparagement of the unique value of a good university course, with its chances of intercourse with many types of intellect and the opportunities the student has of learning the best which has been done and said in the world.

The question of examiners and examinations is dealt with also. We are told that "the professional examiner, he who makes it his business to range from place to place imposing mechanical tests wholesale, is one of the new terrors of life." We are not introduced, however, to the evil effects of examinations upon the examiners. The examiners are, in many cases, distinguished men of science who eke out insufficient emoluments by undertaking examining work in their leisure hours—time which, in a rationally organised system that recognised the workman to be worthy of his hire, would be devoted to research work. Enough has been heard of the evil effects of examinations upon students, and, indeed, much has been done in the direction of judicious inspection to remedy these, and it is time to recognise that the employment of eminent leaders in science to do the work which competent teachers can perform better is an improvident use of our best intellects.

We notice, in conclusion, that Prof. Allbutt sums up the end of education to be action. "We learn, that we may do," he says. The educated man must not rest satisfied with his education, and be content selfishly to enjoy the intellectual gratifications placed at his disposal. Like each one of us, the educated man is one member of a complex society with many needs to be satisfied, many abuses to be swept away, many wrongs to be redressed. The privileges the educated man has enjoyed, and the sources of satisfaction his education has revealed to him, should serve as incentives urging him to work for the advancement of his race and the further development of human society.

A. T. S.

A MARE'S NEST.

The Utilisation of Nitrogen in Air by Plants. By T. Jamieson. Pp. 82+18. (Aberdeen: The Agricultural Research Association, 1905.)

MATTHEW ARNOLD has somewhere a finely ironical passage in which he comments upon the British habit of labelling its institutions with a great name without considering whether they possess any great thing to correspond, and certainly the name of "Research" has rarely been more taken in vain than in the present publication. The Agricultural Research Association appears to be a body of gentlemen in the neighbourhood of Aberdeen who maintain certain experimental plots under the direction of Mr. T. Jamieson. It is further assisted by grants from the County Council and from the Board of Agriculture, and it has issued the above report for 1905, heralded by some startling preliminary trumpets in the Scottish Press. Briefly speaking, Mr. Jamieson claims to have "discovered" "that plants generally absorb free nitrogen directly from the air, and transform it into albumen." He proposes to wipe out agricultural science between the dates of De Saussure and himself, writing, indeed, with a curious resemblance to the amateur speculations of sixty years ago.

Mr. Jamieson begins by demolishing, to his own satisfaction, the theory that leguminous plants fix nitrogen by the agency of bacteria, and the quality of his argument may be gauged from the following passage:—"It should be borne in mind, also, that bacteria were *never proved to be present*. The small particles found in the tubercles were merely *assumed* to be bacteria." What are we to say to a man who proposes to dismiss the nineteen years' work of some scores of investigators in every country by denying a fact he could demonstrate to himself at any moment had he the most elementary acquaintance with the manipulation of bacteria? But no; Mr. Jamieson prefers to speculate on his own, without even reading up the subject. There is a curious footnote on p. 29 which, we imagine, is meant to display Mr. Jamieson's acquaintance with the literature of nitrogen fixation; a list of authorities is given, equally amazing as regards either its inclusions, its omissions, or its spellings of proper names. Beyerinck appears variously as Burginck and Beirjerenck. But when we leave Mr. Jamieson's criticism and turn to his constructive work the result is even more amazing. He takes an ordinary plant, spurrey, for example, and finds certain hairs on the leaves. To ascertain the purpose of these hairs he applies to them iodine or some other reagent capable of staining proteid. He finds that the tips of these hairs, which are at first empty and then become green with chlorophyll, give later a reaction for albumen, which disappears again as the hairs age. "If the formation of albumen takes place in the tip of this hair, one would expect to find its absence in the early stage, its presence in the later or active stage, its discharge through the channels and round the cells of the plant, and its possible absence in the latest stages—and this is what has actually been found."

"The evidence that nitrogen is absorbed by these tips, and is there fixed and manufactured into albumen, is thus as complete as could well be desired." "The direct absorption of nitrogen, and its direct fixation as albumen, thus seems demonstrated even more satisfactorily than is possible by chemical analysis," and none, accordingly, is attempted. "'Tis safer so," as the American poet puts it. Mr. Jamieson does not bring forward a single experiment to demonstrate that nitrogen has been fixed by any of his plants; this fundamental fact (?) he assumes.

The fact that many investigators like Boussingault and Lawes and Gilbert found no fixation of nitrogen during the growth of plants Mr. Jamieson dismisses on the ground that the plants under experiment had not attained their normal vigour, forgetting that Lawes and Gilbert had dealt with and dismissed this very point in their field experiments upon root crops. Mr. Jamieson even argues that the growth of the leafy turnip crop with small or no nitrogenous dressings implies that the crop has drawn its nitrogen from the atmosphere, whereas this is the standard example in the lecture-room of how the great reserves of nitrogen in the soil can be made to feed the plant if nitrification be promoted by the frequent cultivations and the high soil temperatures which characterise the growth of the turnip crop.

It is on this sort of foundation that Mr. Jamieson proposes to re-build the whole edifice of agricultural science; really the thing would be amusing were it not so dangerous and discreditable to the cause of scientific research. Mr. Jamieson has a following. Putting aside his official backing, and the dukes, earls, and marquises who figure as patrons, there is a body of solid farmers and landowners who sit under him and take advice on practical matters which they suppose to represent the last word of science. Accustomed to the amenities of theological disputation, these men like their agricultural science in the same style; not the dry light of reason, but a strenuous assertion of a monopoly of the truth, rhetoric and passion, and a vigorous denunciation of the other side—all these they get from Mr. Jamieson. But it is a windy diet, and sooner or later disagrees with the subject, whereupon science gets the blame.

A. D. H.

OUR BOOK SHELF.

Technical Methods of Ore Analysis. By A. H. Low. Pp. x+273. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.)

This book is of interest as showing the exact methods of analysis of ores in use in the United States at the present time. The author is a member of a well known and old-established firm of analysts and assayers in Denver whose results are accepted with respect by miners and smelters in the western States. It is unusual for such a man to publish exact descriptions of the methods used in his office, as any discoverable flaw in a method might be seized on and magnified by his rivals with prejudicial results to his business. Now that Mr. Low has shown so much courage, his example may be followed.

The book contains detailed descriptions of the estimation of the ordinary constituents of ores, omitting all "fire methods" of assay. The details are minute enough to be tiresome in reading the book through, the account of the precautions to be taken in volumetric analysis, for example, being repeated whenever a volumetric method is reached. In this swarm of details the salient points of the methods are lost, and as the headings are somewhat vague, careful search is necessary to find out what method is being described. An analyst must generally read the whole of a section if he wishes to refresh his memory on some particular point, and will count himself fortunate if he has hit on the right section. Nevertheless, the point will probably be in the book, to be discovered by perseverance.

The methods are usually good and carefully described. It seems a pity that Mr. Low should designate the determination of zinc by ferrocyanide the "author's method," without referring to Galetti or Fahlberg, to whom he is indebted for so much, but there is probably no intention to deceive. Also, in the estimation of copper by iodide, the practice of adding a solution of potassium iodide, instead of crystals, is recommended without any warning as to the decomposition of the solution if it is kept for some time. However, the book is generally trustworthy and useful. There is no book like it, and the analyst will naturally have a copy on his shelf.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities. By Charles G. Barrett. Vol. x. Pp. 384. Heterocera: Pyralidina Tortricina. (London: Lovell Reeve and Co., Ltd., 1905.)

Since our notice of the last volume of this work entomologists have to regret the death of the accomplished author, well known as one of the best practical lepidopterists in England long before he commenced the elaborate monograph which he did not live to complete. Hitherto, however, there has been no interruption in the publication of the successive parts, and we understand that the manuscript was left practically complete to the end of the Tortricina, which is the more satisfactory as the Tortricina are a large and difficult group which have been somewhat neglected by most British lepidopterists, but to which Mr. Barrett devoted special attention.

The families included in vol. x. are Pyralidina; Phycitidæ (conclusion), 13 genera (Cateremna to Plodia); Anerastiidæ (genus Anerastia), Crambidæ (6 genera), Galeriidæ (5 genera), Tortricina, Tortricidæ (17 genera), Cnephasidæ (5 genera), Lozoperidæ (7 genera), Sercoridæ (commencement, 4 genera).

The general arrangement of the present volume is similar to that employed in preceding volumes, and the remarks on the habits of the insects are detailed and interesting. For example, we are told that the first species in the volume (*Cateremna terebrella*, Zinck.) has a curious habit of emerging during thunderstorms, these being, as is well known, frequent in the eastern counties. The history of the various species, small and inconspicuous as many of them are, is very fully given throughout.

W. F. K.

A First Reader in Health and Temperance. By W. Taylor. Pp. iv+219. (London, Westminster: Church of England Temperance Society and G. Philip and Son, Ltd., n.d.) Price 1s. 6d.

In this small book the instruction is given in forty-three lessons wherein all difficult words are avoided so far as possible, and when such words are necessary their meaning is always explained. The elementary matter dealt with is suitably illustrated, and the work is in every respect to be commended.

The various physiological requirements of the body are explained in simple language, and it is shown that alcohol is not only unnecessary but may be actually detrimental to every healthy function. Abstention from alcohol is, in fact, the dominant text of the book.

It is not easy to conceive a book better suited to meet the needs for which it is designed. The subject of personal hygiene is made interesting and it is treated in a very happy and lucid manner, appropriate to the intellectual powers of young children, for whom the book is designed to serve as a first reader.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spectral Series in Relation to Ions.

As I have already shown (*Physik. Zeitschr.*, vi., 892, 1905), the observation of the Doppler effect on the Kanal-strahlen permits the detection of spectra emitted by the positive ions (Kanal-strahlen). I have made such researches on Kanal-strahlen in hydrogen, potassium vapour, and mercury vapour in cooperation with Messrs. S. Kinoshita, K. Siegl, and W. Hermann. We shall give details of our methods and measurements in separate papers; but here I wish to state the principal results of the researches, together with some general conclusions.

The series of lines (Hα, Hβ . .) of hydrogen is a first subordinate series. Its lines are revealed by accurate analysis as pairs or doublets. The difference of wave-lengths of the two components is, as Michelson has found (*Phil. Mag.*, xxxiv., 280, 1892), 0·14 Ångström unit for Hα and 0·08 Ångström unit for Hβ; the measurements made by Ebert (*Wied. Ann.*, xliii., 790, 1891) give 0·132 Ångström unit for Hα. In every other first subordinate series of doublets, and also in the case of hydrogen, the difference in oscillation frequencies of the components of the doublet is constant throughout the series; this difference is for Hα 0·33, for Hβ 0·34 per 1 cm. path *in vacuo*. My previous and recent observations lead to the conclusion that the first subordinate series of doublets of hydrogen has as carriers monovalent positive atom-ions, *i.e.* atoms of hydrogen which have lost a single negative electron.

A second subordinate series of lines of the hydrogen has been observed in certain stars. From their spectral position, Rydberg (*Astrophys. Journ.*, vi., 233, 1897) has calculated the principal series of hydrogen; he gives to the first line of it the wave-length 4687·88 Ångström; this line has been observed in stars with bright lines. It is found also (somewhat displaced) in all spectrograms I have taken of the kathode rays or Kanal-strahlen, partly alone and partly in cooperation with Mr. Kinoshita. This line of the principal series—it may be termed Hβ—shows also the Doppler effect in the Kanal-strahlen, the quantity of the effect being the same as for the first subordinate series of doublets; the principal series of the hydrogen, which is also composed probably of doublets, has therefore the same carrier as the first subordinate series, namely, the monovalent positive ion of hydrogen.

In cooperation with Mr. Siegl I have further examined another doublet of a principal series, namely, the second doublet of the principal series of potassium (λ 4047·36–4044·29). Both components show the Doppler effect in the Kanal-strahlen, and the amount is the same as that calculated for an atom of potassium which has lost a single negative electron. Therefore, in the case of the alkali-metals also, the principal series of doublets has monovalent positive ions as carriers.

In the spectrum of mercury hitherto only series of triplets have been found—a first and a second subordinate series (Kayser and Runge). Using a small concave grating kindly lent to me by Prof. Runge, I succeeded, in cooperation with Mr. Hermann, in examining the Doppler effect on the lines of mercury. It was found that all components of triplets, and further all triplets of a series, have the same positive ion as carrier, and, moreover, the lines of the first and of the second series show the same Doppler effect in type and quantity. Both series of triplets of mercury have therefore the same carrier, the bivalent positive ion of mercury; for the Doppler effect really found agrees in quantity with the effect calculated theoretically for an atom of mercury which has lost two negative electrons.

The lines of mercury not belonging to the series of triplets show likewise a Doppler effect, but there is a difference in character and amount between them and the lines of the two series of triplets. There are lines which show a larger effect than the series of triplets; the carrier of these lines is therefore a positive ion of mercury of higher valency, *i.e.* an atom of mercury which has lost more than two negative electrons. To these lines of higher valency belongs the line λ 4078·1.

Finally, there are lines in the spectrum of mercury which show a smaller Doppler effect than the lines of the series of triplets; their displacement is roughly 1·5 times smaller than that of a line of a triplet of equal wave-length. Therefore they have as carrier not a bivalent, but a monovalent positive ion of mercury. To these lines belong the wave-lengths λλ 2536·72, 4339·47–3021·64, 3984·08–2847·85. It seems that λ 2536·72 is the first component of a principal series of doublets, that the pair λλ 4339·47–3021·64 belongs to a first, and the pair λλ 3984·08–2847·85 to a second subordinate series of doublets. This being so, mercury confirms the view that the principal and the first and second subordinate series of doublets have monovalent positive ions as carriers.

Generalising the foregoing results, we have come to the following conclusions:—The carriers of the spectra of lines of the chemical elements are positive atom-ions. All lines of a series have the same carrier, and, moreover, the same carrier may emit several series at the same time. The carrier of the principal series and of the subordinate series of doublets is a monovalent positive atom-ion; the carrier of the subordinate series of triplets is a bivalent positive atom-ion; ions of a higher valency emit likewise line spectra, but the structure of these is not yet recognised. The spectrum of an element, for example, that of mercury, may represent a mixture of several spectra, namely, of the spectra of its monovalent, bivalent ions, and of ions of higher valency.

The foregoing results and conclusions are in striking agreement with the results which were arrived at by Runge and Paschen (*Ber. d. Berliner Akad.*, 1902, 380, 720) in their researches on the Zeeman effect of series of lines. They found that the principal series of doublets of all elements examined (Na, Cu, Ag, Mg, Ca, Sr. Ba) show in type and amount, when measured in oscillation frequencies, the same Zeeman effect; this also holds good for the first and the second series of doublets. The first and second subordinate series of triplets show in type and amount another Zeeman effect than the series of doublets; but the series of triplets of different elements are again in the same way broken up by a magnetic field. The agreement of my results with those of Runge and Paschen comes out in the following detail:—The lines of mercury (λλ 2536·72, 4339·47, and 2847·85) referred by me to series of doublets must show in a magnetic field the known splitting up of the lines of the principal and of the subordinate series of doublets. Runge and Paschen enumerate these lines under those which do not show the behaviour of triplets, and, in fact, their statements on the magnetic behaviour of those lines are concordant with that postulate.

It follows from the Zeeman effect that the centres of emission of series of lines are periodically accelerated negative electrons. From the complexity of their magnetic splitting up we may draw the conclusion that these centres of emission—the negative electrons—are coupled in electrodynamic systems; the electrodynamic structure of these systems of negative electrons is for the emission of series of doublets rather than for the emission of series of triplets.

We do not know of spectra of neutral atoms. It follows from the foregoing results that the known spectra of lines can only be emitted if the chemical neutral atoms have lost negative electrons, and thus have become positive atom-ions. Therefore the electrodynamic symmetry of the system of negative electrons in the positive atom-ion is different from the symmetry in the neutral atom. Certain systems of negative electrons have in the positive monovalent ion an electrodynamic symmetry which enables them to emit radiation of electromagnetic energy; this symmetry is characterised by the emission of doublets. Losing two or more negative electrons a neutral atom also gains an electrodynamic symmetry capable of radiation; but the

electrodynamic symmetry in the bivalent ion is different from that in the monovalent ion; it is characterised by the emission of triplets.

Spectroscopically the chemical elements show a uniform behaviour in a striking way. Their monovalent ions emit series of doublets of analogous structure and identical magnetic behaviour; their bivalent ions emit series of triplets likewise of analogous structure and identical magnetic behaviour. From element to element the variables are only the proportions of the spectra or the constants of the laws of the series of doublets and triplets.

Göttingen, March 5. J. Stark.

The Kew Bulletin.

A few words of explanation may be useful to anyone interested in the Kew Bulletin. It was started in 1887, partly to meet a suggestion made in the House of Commons and partly to serve as "an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire." It has been the vehicle for the publication of a vast amount of information of various kinds, some on purely scientific, but mostly on economic subjects. The number of copies printed has necessarily been limited, but it has always been hoped that the Press would aid in the further diffusion of information of general interest to the public.

The volumes before 1892 have long been out of print. To meet this difficulty, selected papers which proved to be of permanent interest have been from time to time reprinted.

Since 1901 the Bulletin has been somewhat in abeyance, though the routine appendices which are required for various purposes have been kept up. The fact is that to produce the Bulletin satisfactorily requires what it has never had—some sort of staff which would be specially charged with it. The volume of work which falls on Kew is little understood. Besides its own routine and administrative duties, Kew acts as technical adviser to all Government departments at home, as well as in a varying measure to India and the colonies. For many years the annual number of letters sent out has averaged about 14,000, which is about two-thirds of that of the Commercial Department of the Foreign Office. The publication of the Bulletin has simply been crowded out.

My functions as director ceased on December 15, but I was retained in a consultative capacity until March 31. In order to give my successor a clear start I have done my best in the interval to clear off arrears. The third and concluding volume of the "Index Floræ Sinensis" has been issued. An eighth volume of the "Flora of Tropical Africa" has been all but passed through the press. The long delayed "Wild Fauna and Flora of the Royal Botanic Gardens" has been published. A catalogue of the exhibited collection of portraits of botanists has been prepared and is in type, and a second edition of the "Hand-list of Ferns and Fern-allies cultivated at Kew" is in the printers' hands. A third quinquennial supplement to the "Index Kewensis" is being prepared for the press.

The continuation of the "Flora Capensis" is being actively pushed forward, and other much needed undertakings are in view.

In order to restore the Bulletin to something like vitality, it was thought advisable to issue in one or more numbers for each year such matter as was available, with title and table of contents. This will allow the annual volumes to be bound, and the series made continuous to the satisfaction of careful librarians. The volumes for 1900 and 1901 are already issued, and the succeeding ones will follow immediately. A word of acknowledgment must be given to the generous aid of the new and active Controller of H.M. Stationery Office in expediting the work.

The director has taken up the publication of the Bulletin from the present year, and will, I hope, be able to continue it, but on a somewhat more elastic plan. No attempt will be made to issue it monthly, but material and documents of general interest will be printed at once.

Kew, March 30. W. T. Thiselton-Dyer.

Interpretation of Meteorological Records.

I quite agree with Mr. Omond's remarks in Nature of March 29 with regard to the heating of downward moving air, that if it had been simply a case of air which had previously been in thermal equilibrium and moved downwards its temperature would have been raised to that of the lower air; but in this case it was a mixture of air and water, and the water would absorb the heat produced by the compression of the air, and, further, any little heating that might not be so absorbed would increase the dryness of the air, and so cause evaporation and absorption of heat.

With regard to the effects of electricity on rainfall, they are much too little understood to be entered on here, but it may be stated that a sudden fall of rain, or an increase in rate of fall, is often observed very shortly after a flash of lightning. John Aitken.

Ardenlea, Falkirk, N.B., March 31.

Request for Prints of Photographic Portraits.

I should be grateful to your photographic readers, whether amateur or professional, who would send me, within the next two or three weeks, waste photographic portraits, to be cut up, mounted, reduced to a miniature scale, and so to be published *without names*. They are wanted in considerable numbers to control results at which I have already arrived, relating to resemblance. Family portraits would be particularly acceptable. I make this appeal, finding it extremely troublesome, as well as costly, to obtain the needed material in other ways. Francis Galton.

42 Rutland Gate, London, S.W.

Peculiar Ice Formation.

As the question of earth-bearing ice-pillars has been recently raised in your columns (pp. 464, 485), there are one or two points to which I should like to direct attention, as they may be of interest to your readers. While working in company with a colleague on Divis Mountain, Belfast, in 1902, our attention was attracted by the peculiar formation of ice so admirably described by your correspondent of March 15. It seemed perfectly obvious that the ice-pillars had, in growing, lifted the earth and stones by exerting a pushing force in the direction of their length, and that without lateral support, putting the expansive force of water on freezing out of the question as an explanation. All doubt on this point was removed by our finding an impression of a nailed boot, made in the mud before the frost, and on which the pillars had grown on all parts of the mud on which there were no impressions of nails, and were wanting wherever the nails had been. This gave a curious effect, as if the boot had been shod with long spikes, each nail being represented by a narrow cylindrical pit an inch and a half deep. The pressure of the nails had evidently destroyed the conditions which led to the formation of the pillars.

I was unable to determine whether the ice in each pillar was in crystalline continuity, but there was nothing to lead one to suspect the contrary. I thought I could distinguish a rude hexagonal form in some of the pillars, but this may have been merely chance. On the whole, it would seem as if the idea that a growing crystal is capable of exerting a mechanical force in some definite direction is not entirely without support. Such a force would go far towards explaining many peculiarities of the natural growth of crystals. Take, for example, the horizontal veins of fibrous gypsum so common in the Keuper Marl. It is impossible to conceive of the formation in soft rocks of a horizontal fissure of the extent of some of these veins, and it is difficult to escape from the conclusion that the growth of the fibrous crystals forced apart the sides of the vein, lifting the enormous weight of rock above. This suggestion is by no means a new one.

W. B. Wright.

28 Jermyn Street, S.W., March 27.

Formula for finding the Date of Easter.

IT may be of interest to some of your readers to know of the following empirical formula—attributed to the famous mathematician Gauss—for determining in an easy manner the date on which Easter falls in any year from 1900 to 2100:—

(1) The number of the year is divided by 19; remainder $= a$.

(2) The number of the year is divided by 4; remainder $= b$.

(3) The number of the year is divided by 7; remainder $= c$.

(4) $19 \times a + 24$ is divided by 30; remainder $= d$.

(5) $2 \times b + 4c + 6 \times d + 5$ is divided by 7; remainder $= e$.

Easter will be the $22 + d + e$ of March, or, if this number exceed 31, it will be the $d + e - 9$ of April.

The calculation for the present year is as follows:—

$$(1) \quad \frac{1906}{19} = 100 + 6 \quad \ldots \quad (a = 6)$$

$$(2) \quad \frac{1906}{4} = 476 + 2 \quad \ldots \quad (b = 2)$$

$$(3) \quad \frac{1906}{7} = 272 + 2 \quad \ldots \quad (c = 2)$$

$$(4) \quad \frac{(19 \times 6) + 24}{30} = 4 + 18 \quad \ldots \quad (d = 18)$$

$$(5) \quad \frac{(2 \times 2) + (4 \times 2) + (6 \times 18) + 5}{7} = 17 + 6 \quad \ldots \quad (e = 6)$$

As $22 + 18 + 6$ is in excess of 31, we take the alternative $18 + 6 - 9 = 15$, on which day of April Easter falls this year.

CHAS. LEIGH.

The Victoria University of Manchester, March 30.

Chinese Names of Colours.

IN your issue of January 11 (p. 246) Mr. Alfred H. Crook writes respecting the name given by the Chinese to a certain tint of blue, which he translates quaintly as "snow-green colour." The following explanation may be of interest to him and to others of your readers.

雪 *Hsüeh*, the word he translates "snow," also means "ice," and to the natives of southern China is far better known in reference to the latter object than to the former, as the same name is applied to both natural and artificial ice.

青 *Tsing* originally meant "clear," "tranquil," "smooth" (applied to water). The change from "smooth water" to the "colour of smooth water" is an easy one, so that a secondary meaning of the word is "sea-green" or "sea-blue." Quite different words are used to express other green tints, such as grass-green, and other blue tints, such as indigo-blue.

Putting the two words together, one finds the meaning of 色 青 雪 (*hsüeh tsing seh*) to be "ice-blue colour" or "blue ice colour." Anybody who has noticed the tint of ice in great masses such as one gets in north China and in Switzerland, and who has seen the colour referred to by Mr. Crook, will agree with me in saying that the name given by the Chinese, far from being fanciful, is very appropriate.

L.

Hong Kong, February 15.

The Adulteration of Butter.

MY attention has been directed to an article in your issue of March 15 on "The Adulteration of Butter" in which your contributor refers to the composition of butter fat as a triglyceride of oleic, palmitic, and butyric acids, or as containing such a substance. Some years ago I traced this opinion to Mr. Bell, a former analyst of Somerset House, who appears to have based his conclusions upon the insolubility of butter fat in alcohol. Butter fat is, however, soluble in alcohol, and I have no doubt whatever that a process of fractional precipitation from this solution would enable us to ascertain with fair accuracy what the real constituents are. My own experiments certainly pointed to a great number of separate glycerides being present, palmitin and stearin separating out in tolerable purity. The separation of the lower fatty acid compounds is more difficult to attain, probably owing to their existence as esters. It would be interesting to know whether the theory of the presence of triglyceride rests upon a more stable foundation than that of Bell's statement.

J. H. LESTER.

Royal Exchange, Manchester, March 17.

YOUR correspondent scarcely does justice to Dr. Bell's observation.

Whether butter fat is completely soluble in alcohol or not depends upon the volume, strength, and temperature of the solvent. Bell showed that when the simple glyceride tributyrin was mixed with melted ordinary fat to the extent of 10 per cent., it could be entirely removed by treatment with warm alcohol. But when butter fat was similarly extracted, from 2 per cent. to 3 per cent. only of the fat was dissolved out, and the soluble portion was not tributyrin. Therefore the butyric acid of butter fat is not present as the simple glyceride tributyrin, but chiefly or wholly as a mixed glyceride. Further, the portion dissolved from the butter was found to contain "soluble" and "insoluble" acids in proportions agreeing closely with those required for the mixed glyceride oleo-palmito-butyrin.

Some years later (Proc. Chem. Soc., 1889) Blyth and Robertson noted the isolation from butter fat of a crystalline mixed glyceride, to which they ascribed the formula of palmito-stearo-butyrin.

The "presence of triglyceride" in butter fat will hardly be questioned; what your correspondent has in mind is, apparently, the occurrence of mixed (*i.e.* complex) glycerides. Many such have been isolated from various natural fats in the last few years; this is, in fact, the most notable feature in the recent chemistry of fats. That complex glycerides exist in butter Bell's and Blyth's experiments leave no reason to doubt, though more rigorous proof of their precise composition is desirable.

March 20. C. SIMMONDS.

The Existence of Absolute Motion.

IN discussing this question it is surely necessary to place stress on the contrast between the places of absolute direction and absolute position in dynamics. The result of observation is that the laws of motion are competent to explain such phenomena as nutation and retain the simple Newtonian form when certain directions which can be found with reasonable accuracy are assumed to be absolute. The contrary assumption, that these directions were not absolute, but moving with absolute angular velocities, say of the order of one degree per second, would necessitate a re-statement of the laws of motion involving great loss of simplicity. In the same way, we cannot without loss of simplicity suppose that the acceleration of the earth with respect to the centre of the solar system differs greatly from the absolute acceleration, and suggest that the material universe has an absolute acceleration of the order of one hundred miles per second per second.

On the other hand, the laws of motion would not be modified in the slightest if the whole universe possessed a uniform and constant absolute velocity, however great that velocity might be, even, for example, ten times the velocity of light. Compared with such a velocity as this, the velocity of the solar system relative to the centroid of the visible stars is probably insignificant. Evidence as to the existence of such a velocity must be sought elsewhere; dynamics alone will not supply it.

F. J. W. WHIPPLE.

Merchant Taylors' School, E.C.

SAILING CRAFT IN EUROPE AND ASIA.[1]

In these days, when sails are falling more and more into disuse for ocean-going vessels, and the construction of sailing-ships is a dwindling industry, it is refreshing to come across a book like this, breathing throughout an intimate knowledge of sailing-ships and sailors, displaying insight into, and sympathy with, the nature of the men who follow the sea on the coasts of many countries, and showing in every page powers of quick observation and ready understanding of all that makes for the efficiency of sailing craft. The author indicates his recognition of the inevitable triumph of the steam-ship in competition with the sailing-ship for purposes of both peace and war, but he rejoices no less in the belief that throughout all time fishing- and coasting-vessels will remain dependent upon sails, and so will constitute a school of seamanship in which the traditions of the past will be maintained. Mr. Warington Smyth describes the volume modestly as "an attempt to record the peculiarity of the principal types of sailing craft in Europe and Asia which I have observed . . . and to consider the causes which have been at work in the development of boats and the results attained under the conditions with which they have had to contend."

This attempt has been eminently successful, and has resulted in the production of a book which is a perfect treasury of information on the subject treated, is well arranged, brightly written, and beautifully illustrated. The author has received the assistance of many competent authorities in special classes of vessels described. Captain Drechsel has dealt with Danish vessels; Mr. Colin Archer, the well known naval architect of Larvik, has been responsible for details of Norwegian types; Mr. Robert Duthie, of the Scottish Fishery Board, has given valuable information in regard to the Scottish fisheries, and other friends have assisted in regard to extra-European types. The descriptions are arranged in geographical divisions, which is not merely the most natural scheme, but also that which best brings into relief the underlying motive of the book, namely, the illustration of the influence of local conditions upon form, type, and sail-plan. Other writers, notably the late Mr. Dixon Kemp, and those who, since his death, have continued the revision of his work on "Yacht and Boat Sailing," have emphasised the influence of local conditions, and gathered large stores of information illustrating the general principle. In most cases these writers have dealt with the subject from a more technical standpoint than that assumed in the volume under review. It must not be assumed, however, that Mr. Warington Smyth has neglected technicalities or unduly sacrificed them to a popular treatment of his subject. On the contrary, for many classes of sailing-vessels he gives the "lines" (or building drawings) and the sail-plans, and his portraitures of both hulls and sails in the vignettes scattered freely throughout the text are admirable in their details. The interest of the book is increased by the introduction of numerous reproductions of famous pictures of shipping, and no pains have been spared by the publisher either in regard to these illustrations or to other features for which he is responsible.

Mr. Smyth excludes from his survey pleasure boats, yachts, and square-rigged vessels, and gives adequate reasons for that course. About one-half of the book is devoted to European types, beginning with the Baltic and Scandinavian countries, and passing to Holland, Scotland, the east coast of England and the Thames estuary, the south and west coast of England, and then to France and the Mediterranean. To English readers, probably the most interesting section of the book will be that dealing with Eastern vessels, including those of the Indian Ocean, the Malay Peninsula, the Gulf of Siam, and China. Here we find special types of great antiquity, differing widely from Western vessels, but well adapted for their special services and surroundings. Mr. Smyth combines philosophical reflection with a yachtsman's enthusiasm and a technical knowledge which goes beyond that of the ordinary amateur, and this fact adds to the charm of his book.

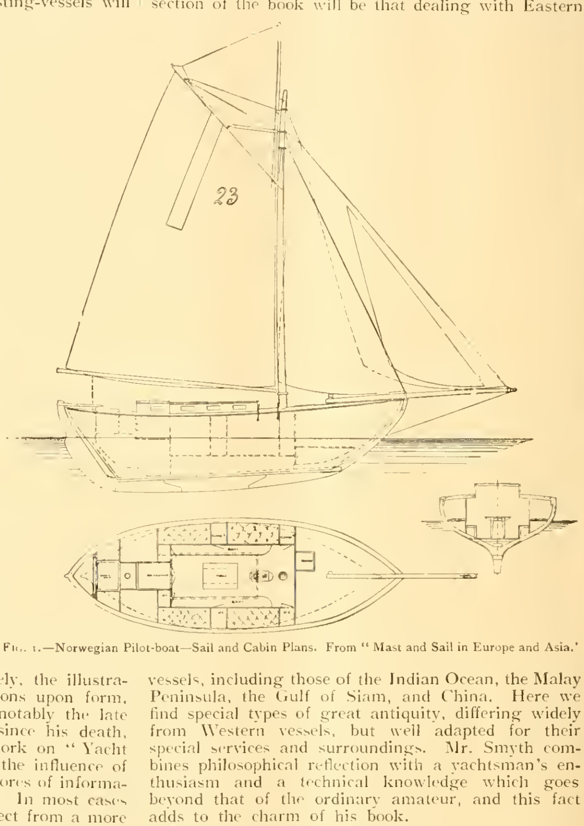


Fig. 1.—Norwegian Pilot-boat—Sail and Cabin Plans. From "Mast and Sail in Europe and Asia."

One quotation may be permitted, even within the limited space available in this notice, as indicating this side of his work. He says:—"It is probably true that the degree of civilisation of any race is remarkably reflected in its boat architecture. The variety of its adaptations to the peculiar requirements of its waters is a measure of its appreciation of the value of the cheapest and most certain method of communication known to man; and it is evidence of

[1] "Mast and Sail in Europe and Asia." By H. Warington Smyth. Pp. xix+448. (London: John Murray, 1906.) Price 21s. net.

its ability to use materials at command and fit them to its needs. The highest degree of civilisation in maritime races has always been marked by activity in boat-building and by variety of design and rig. In no case has this been more notable than in the history of China and of Holland, and in the Adriatic in the fifteenth century, in Europe during the last two centuries and in the United States since 1780. The Negro, the American Indian, and the Slav, on the other hand, have never designed a sea-going boat or cut a sail. It has not been for want of water-ways or of opportunity. It has been simply owing to a lower class of intelligence and to want of originality and enterprise."

Mr. Smyth's allusions to the indirect influence upon character and resource of life and work in vessels equipped with sail power are also notable:—"It is above all in the men who handle sails that the self-reliance which is bred by tempest, darkness and the shadow of the Angel of Death reaches its highest point. The seriousness, from this point of view, of the loss of masts and yards to the Navy has been fully recognised, and it has only been reluctantly acceded to on account of the pressing importance of other more essential forms of training. But amongst the coasters and fishermen of the world the mast and sail more than hold their own; and here a student of the sea will find himself in a by-path of the modern world, among the old thoughts, the old traditions, the old methods, and the old virtues of the great seas. And when this civilisation shall have condemned itself and passed the way of others, the lug-sail and the lateen will still be navigating the deep, conned by other races, but the same grim, great-hearted sailor men."

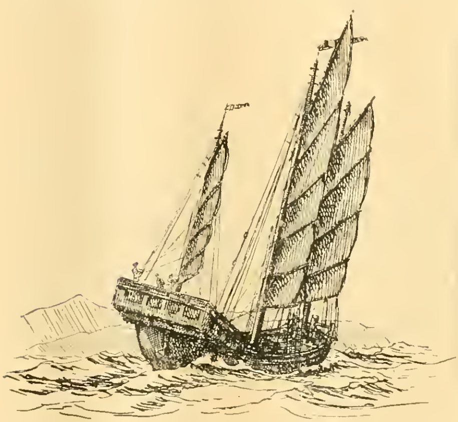


FIG. 2.—Hong Kong Junk. From "Mast and Sail in Europe and Asia."

Enough has been said to indicate that, in our judgment, this book should find a hearty welcome from all who love to sail the seas and manage their own craft, and from all who are interested in the maintenance and development of that hardy race of seamen bred on the coasts of the United Kingdom, and leading a life of hardship, difficulty, and danger which must develop qualities of the highest value to the maritime greatness of the British Empire.

W. H. WHITE.

THE SOLAR ECLIPSE OF 1905.

IT is very satisfactory that reports of the recent eclipse expeditions indicate that at some stations the weather conditions were all that could be desired, because we know that at several stations opportunities for securing good results were frustrated by clouds. The Hamburg Observatory party chose a spot which, however, did not come under the second category, and judging by the first portion of the report published,[1] which deals chiefly with the general arrangements and journey to and from the position of observation, it achieved complete success in all lines of work. The report itself is of great interest, and is accompanied, not only by excellent reproductions from photographs of camp scenes, &c., but by capital pictures of the corona. The style of reproduction here employed is to be highly recommended, and other publishers of reports might with advantage copy the good example set.

The party was not a very large one. It consisted of Prof. R. Schorr, the director of the observatory, Dr. Schwassman, the observer, and an observatory attendant, Herr Beyermann, and they were assisted by Prof. Knopf, director of the Jena Observatory, who joined the expedition.

The station selected and used as the observing position was Souk-Ahras, in Algeria, lying on the railway from Tunis, and to the south-west of Bône. The accompanying illustration shows the station occupied, with the several instruments in position. The work of the expedition was chiefly devoted to the following points:—structure of the inner corona; photography of the outer corona and extensions; a search after intra-Mercurial planets; the determination of the brightness of the corona and the total daylight during the eclipse; contact, meteorological, and other observations. The only spectroscopic work attempted was the employment of a Thorp diffraction grating to secure the spectrum of the corona.

For the attack on the inner corona a horizontal telescope of 20 metres focal length was employed. With this, very excellent photographs were obtained. Perhaps the most interesting part of the account of these photographs is the recording of three or four oval, ring-formed, cloud-like caps which lay at a distance of 4 to 6 minutes of arc above the large prominence on the east limb, and indicated a close connection with the eruptive nature of the prominence. These rings, it may be remembered, were also photographed by the Greenwich Observatory party under the direction of the Astronomer Royal, which observed at Sfax, in Tunisia, so that an independent photographic record of them is very important, as this is the first time they have been caught on the sensitive film. That such phenomena have been previously *seen* will be gathered from the following extract[2] relating to some spectroscopic observations made by Sir Norman Lockyer in 1870:—

"And what was going on, while this was happening? A prominence, obviously with its root some distance from the limb, had gradually travelled beyond the limb; in appearance it became very much more elevated, and seen, as it were, in perspective over the limb; but what I saw first was very rapidly changed, in a way that would be explained by supposing that cyclones were being shot up into the solar air like bombs! the changes in the F line were so rapid and curious. I was not observing with an open slit, so I at once coined the term 'motion forms,' because the forms observed did not in any way represent the shape of the prominence. But the

[1] *Mittheilungen der Hamburger Sternwarte*, No. 10.
[2] "Solar Physics," by Sir J. Norman Lockyer, p. 403.

extreme velocity can be imagined from the great departure of those bright lines from the stable dark line F, seen below them, and not only that, but we can think out the explicit character of this prominence action. *They were really in this case, as already stated, smoke rings thrown up by enormous circumsolar action.*"

We thus see that after the lapse of thirty-five years these "lozenge" forms, as they were then called spectroscopically, have been caught in the mesh of the photographic plate.

For the search after intra-Mercurial planets two objectives of 10 cm. aperture and 4 metres focal length were used equatorially, and plates were exposed for 120 and 63 seconds. So far as the negatives have been examined, no unknown object has been detected, but it is interesting to remark that on both plates Mercury appears of the fifth or sixth magnitude eleven hours after inferior conjunction.

Successful measures were made of the brightness of the corona with a Weber photometer by Prof. Knopf, but the reductions are not yet quite complete.

FIG. 1.—The Hamburg Observatory's Eclipse Camp in Souk-Ahras. The 20-metre coronagraph is on the right, and the twin equatorial planet-finder on the left.

Shadow bands were clearly seen, and the dimensions of those measured were about 50 cm. long and 4 cm. to 5 cm. broad.

W. J. S. LOCKYER.

THE STORY OF AN ENGLISH TOWN.[1]

THE modern changes in literary methods and the demands of the reading public have altered the character of many classes of books, but none has been so much affected as that dealing with topography. The subsidised family history, the elaborate folding pedigrees, plates of armorial bearings or of equally uninteresting tombs of former magnates of the locality, have disappeared from such works, unless their intrinsic interest coincides with that of the subject of the book. Genealogists and students of family history are now provided with publications of their own, surely a change of a practical kind, and one which allows the substantive matter of a topographical work to take its real place. Even when the older fashion is cast aside for the new, however, there are many alternatives in the treatment of local history. Mr. Gordon Home may be said to be thorough in the one he has chosen, for in the course of some 300 octavo pages he traces the story of the district in which Pickering is situated from pre-Glacial times up to the date of his publication, including the geology, the archæology early and later, local legends and folklore; and very good miscellaneous reading he makes of it. The earlier sections, however, can scarcely be said to conform with his title-page, for it is admitted that for many thousands of years after the period of his second chapter no human being yet existed in Britain in the latitude of Pickering, and the town itself would, of course, be even later.

There is, however, no harm in this, and it must be confessed that the admirable material existing in the neighbourhood, and the masterly way in which much of it has been treated by competent hands, offer great temptations to include nature's story as well as man's. The Kirkdale cave is one of the best known of these natural features of the locality, and was exhaustively described by Dr. Buckland in 1822 before the Royal Society, in a paper which is a model of scientific analysis. The physical conformation of the country, the hills around rising to a height of upwards of 1400 feet, naturally provides an admirable field for the observation of the action of ice, and here Mr. Home has taken full advantage of the survey made by Prof. Kendall, while the existence and behaviour of the glaciers in the valleys converging on Lake Pickering in the lesser Ice age are made very clear by the diagrams provided. Naturally enough, there is a good deal of elementary geology in these chapters, and Mr. Home at times also gives his imagination a somewhat free rein, but he does not confuse fact and imagination.

Coming to the later times, where geology gives place to archæological conditions, we are on surer ground; the relics are more plentiful and more directly comparable with similar remains in other localities and even other countries. Hypothesis and even imagination still have their uses, but the more abundant materal should keep the student to the safer zone of comparative archæology. Here again, in the Barrow period, Mr. Home is fortunate in having masters of the craft to appeal to. Dr. Thurnam and Canon Greenwell have both provided ample matter for the story of man during the later Stone and early Bronze ages, and Mr. Home might have drawn upon them more largely with advantage to

[1] "The Evolution of an English Town; being the Story of the Ancient Town of Pickering in Yorkshire." By Gordon Home. Pp. xix+298. (London: J. M. Dent and Co., 1905.) Price 10*s*. 6*d*. net.

his book. A few figures of some of the urns and other relics found by Canon Greenwell in the barrows of the North Riding would have formed more instructive illustrations than the somewhat scrappy and heterogeneous plate of "prehistoric weapons" that faces p. 34. A plate of urns in the Pickering Museum is, indeed, given further on, but it lacks typological qualities. Much has been done during the last few years towards the classification of barrow remains, more especially in the case of the pottery, and there should be no difficulty in presenting a series from so rich a district as Pickering on a plan more in accordance with the results of recent research. In spite of such occasional lapses Mr. Home carries the the reader through the story with considerable skill and vivacity. A later chapter will probably be found the most interesting to the general reader, that dealing with local legends, witchcraft, and folklore. Here there is ample material for a considerable volume, for it is certain that where Mr. Home has gleaned so much there must exist a vast harvest for the trained student. The figure from this chapter reproduced here has been used in sympathetic magic, the universal practice of which Mr. Frazer treats in "The Golden Bough." Traces of Scandinavian importations are frequent, and some of the survivals in local custom have the flavour of a much more remote age. A good deal has already been done in this direction for Cleveland, but it is evidently a fruitful soil and well worth careful and exhaustive treatment. There are some admirable photographic reproductions of the very remarkable, and in some cases beautiful, wall paintings in Pickering Church, and the story of the regulations of the Duchy of Lancaster during Plantagenet and later times is full of quaint customs and interesting matter. The book as a whole has a cheerful air, and may well lead some who are unacquainted with the beauties and interest of Cleveland to pay Pickering a visit.

FIG. 1.—Relic of witchcraft found in the neighbourhood of Pickering. The figure was made of pitch, beeswax, bullock's blood, hog's lard, and fat from a bullock's heart. It was used for casting spells on people, the pin being stuck in the figure where the "ill-cast" was required to fall. From "The Evolution of an English Town."

A few points may be worth the author's consideration if his book should reach a second impression. He seems to be unaware (p. 30) that the Bateman collection of sepulchral urns is now in the museum at Sheffield, and a detailed catalogue was published by the curator in 1899; on p. 45 he states that bronze spearheads have been found in round barrows near Pickering, which seems unlikely; and on p. 48 he figures a quern of a known Roman type in the Bronze age section. On p. 57 an unfortunate slip makes *data* singular instead of plural.

THE GROWTH OF BEET-SUGAR IN ENGLAND.

LORD DENBIGH'S motion in the House of Lords on Monday night, asking for a rebate on the present excise duty on any sugar made in this country from beets during a certain limited period, raises two interesting questions. On one of them the desirability of the State incurring expenditure in order to establish a new industry in the country—we have little to say in these columns; we may be content to point out that it is possible for a Government department to teach the community businesses previously unappreciated. This very beet-sugar manufacture has been introduced into the United States by the action of their Department of Agriculture, with the result that the production has grown to 210,000 tons of sugar in 1904–5 as compared with 20,000 tons ten years earlier.

The other point in dispute is the possibility of growing satisfactory sugar-beet in this country, with its greater rainfall and lower sunshine than the typical Continental centres of sugar production. However, the experiments, organised for so many years by Mr. Sigmund Stein, of Liverpool, and latterly by Lord Denbigh himself, have amply demonstrated that over the east and south-east of England larger crops of sugar-beet can be grown than in Germany without any loss of quality, either as regards the proportion of sugar in the root or its quotient of purity. American experience also shows how adaptable the sugar-beet is to wide diversities of soil and climate.

The English farmer requires but little education in the management of the crop, since the cultivation it requires differs but little from that of the mangel, though the cost per acre is slightly greater. We may take it as settled by numerous experiments extending over many seasons now that the farmer would be prepared to grow sugar-beet in quantity, provided a price were offered approaching that which is paid by the foreign factories, that is, from 16*s*. to 20*s*. per ton of roots. How far the manufacture would be profitable at those rates can only be settled by trial on a commercial scale; a factory must be erected in a suitable district and given a fair working test for two or three years.

While the data available show prospects of a reasonable return on the capital that would be required, one or two difficulties suggest themselves which cannot be resolved except by actual working. The first lies in the provision of labour; the process of manufacture must be practically completed in three months after harvest, and it is doubtful whether labourers could be obtained in this country to work three or four months in the factory and the rest of the time on the land. The other doubtful point is whether the necessary scientific control, for sugar-making from beet is a very specialised piece of chemistry, can be obtained cheaply enough here. Lord Denbigh practically asks the State for a little assistance to get these points settled; with a rebate of the excise duty, equivalent to a bonus of 2*s*. 6*d*. per cwt. on sugar manufactured from beet grown in England, there is a sufficient margin of profit in sight to draw the capital required for the first factory, and a very few years would suffice to demonstrate whether the business would be possible without artificial assistance, or whether the experiment must be dropped.

Without doubt, the establishment of a beet-sugar industry would give the farmer an additional outlet in many parts of the country; it would, however, not work the semi-revolution in agriculture which has resulted from it in many other places. The English farmer already practises intensive agriculture, and the mangel crop, so integral an element in a rotation in the south of England, gives rise to the heavy manuring, the thorough cultivation, and the wealth of food for stock which have been the great benefits conferred by the sugar-beet on the agriculture of Germany and the north of France.

PROF. LIONEL SMITH BEALE, F.R.S.

PROF. LIONEL SMITH BEALE, F.R.S., whose death occurred on March 28 at the age of seventy-eight years, was the son of Mr. Lionel John Beale, and was educated at King's College School and King's College, London. A year after taking his degree in medicine he established a private laboratory in Carey Street, Lincoln's Inn, for pathological, microscopical, and chemical research and teaching; and in 1853, at the early age of twenty-five, was appointed professor of physiology and general and morbid anatomy at King's College. He afterwards held the chair of pathology, and finally that of the principles and practice of medicine at King's College, resigning the latter in 1896. For forty years Prof. Beale was physician to King's College Hospital, and among other honours and appointments received by him during his active career may be mentioned the Baly medal in 1871 for researches in physiology; Croonian lecturer to the Royal Society, 1865; Lumleian lecturer, Royal College of Physicians, London, 1875; president of the Royal Microscopical Society, 1879; and Government medical referee for England, 1891–1904.

As a teacher, Prof. Beale was remarkable for his lucidity; and his lectures were admirably delivered, riveting the attention of his hearers. He had the esteem of all his pupils; and those who had the privilege of a closer intimacy with him feel that they have indeed sustained a great loss by his death.

His principal work, that which gained him the Fellowship of the Royal Society, was on the minute structure of the tissues; "Beale's carmine stain" and his injection mixtures are well known to all microscopists.

Prof. Beale was the author of many works, among the best known being the "Archives of Medicine," containing researches carried out in the laboratory at Carey Street; "How to Work with the Microscope"; "The Microscope in Medicine"; "Protoplasm, Physical Life and Law"; "The Liver"; and "Slight Ailments and their Treatment," besides many papers in the Philosophical Transactions and other publications of learned societies. R. T. H.

NOTES.

The fourteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Mr. R. A. Hadfield on Wednesday, May 2, the subject being "Unsolved Problems in Metallurgy."

The Government of India has decided, with the approval of the Secretary of State, to establish an institute in India as a centre for practical instruction of medical officers and subordinates in the use and management of Röntgen ray apparatus, and as a depôt for the storage and repair of such apparatus. The institute will be located at Dehra Dun, and will be under the superintendence of an officer of the Indian Medical Service.

Prof. R. Meldola, F.R.S., has been made an Officier de l'Instruction publique of France for his services in connection with the foundation of the Alliance Franco-Britannique, of which association he is the honorary secretary.

A Reuter message states that, after perceptible shocks of earthquake, a crevice, out of which lava flowed, opened on the side of Mount Vesuvius, on March 28, some hundred yards from the upper station of the Funicular Railway. The eruption from the principal crater also continues.

At the Meteorological Office Mr. R. G. K. Lempfert has been appointed superintendent of the statistical branch, Mr. Ernest Gold has been selected for appointment as superintendent of the instruments branch, and Mr. J. A. Curtis succeeds Mr. J. S. Harding as cashier and chief clerk.

The Easter excursion of the Geologists' Association will this year be to Lyme Regis. The party will leave London on Thursday, April 12, and return to town on Tuesday, April 17. A detailed itinerary and time-table has been published by the association. The excursion will be directed by Dr. H. B. Woodward, F.R.S., and Mr. G. W. Young, the excursion secretary.

The death is announced of Mr. Carl Heinrich von Siemens. Born in 1829 at Menzendorf, in Mecklenburg, he was the sixth son of a family of fourteen. For the greater part of his life he cooperated with his brothers Werner, William, and Friedrich in the development of the various undertakings with which the name of Siemens is associated. A detailed notice of his career is published in the *Engineer* of March 30.

According to a Laffan telegram from New York, dated March 31, the De Forest Wireless Telegraphy Company has been sending experimental messages from its station at Coney Island to Ireland every night for some time, and on March 28 a thousand words were transmitted, of which 572 were received and recorded. The longest distance that had previously been covered by this company's service was from Coney Island to Colon, 2100 miles; the new record is 3200 miles. The sending stations in Ireland are not yet completed, so that a tetrahedral kite is used temporarily for receiving work.

The following are among the lecture arrangements at the Royal Institution after Easter:—Prof. W. Stirling, three lectures on glands and their products; Dr. P. Chalmers Mitchell, two lectures on the digestive tract in birds and mammals; the Rev. J. P. Mahaffy, two lectures on (1) the expansion of old Greek literature by recent discoveries, (2) the influence of ptolemaic Egypt on Græco-Roman civilisation; Prof. W. J. Sollas, F.R.S., three lectures on man and the Glacial period; and Sir J. Dewar, F.R.S., two lectures on the old and the new chemistry. The Friday evening meetings will be resumed on April 27, when Prof. J. W. Gregory, F.R.S., will deliver a discourse on ore deposits and their distribution in depth. Succeeding discourses will probably be given by the Hon. C. A. Parsons, F.R.S., Prof. J. H. Poynting, F.R.S., Prof. A. Schuster, F.R.S., Mr. L. Hill, F.R.S., Prof. H. Moissan, F.R.S., Sir James Dewar, F.R.S., and others.

In the House of Commons on Monday, Sir W. Foster asked why dead specimens of cancer, preserved in a non-deleterious fluid, have been declared to be forbidden admittance to the post, and why certain specimens, addressed to the Imperial Cancer Research Fund, were ordered to be destroyed immediately on their arrival in this country from abroad. In the course of his reply, Mr. Buxton said:—"The cancer specimens addressed to the Cancer Research Fund are, I am informed on the highest authority, harmless; and, as I am assured that the use of the post is of great importance for the successful prosecution of the researches of the fund, I hope to be able to make a special exception in their favour. I think it desirable, however, that the matter should be discussed with the delegates of the countries principally concerned at the approaching Postal Congress, and I have instructed

the British delegates accordingly. In the meantime, packets addressed to the Cancer Research Fund will be delivered."

The following awards of medals and other honours for this year have just been decided by the council of the Royal Geographical Society:—A Royal (Founder's) medal to M. Grandidier, for the results of his many years' work on the island of Madagascar; a Royal (Patron's) medal to Dr. Robert Bell, F.R.S., director of the Geological Survey of Canada; the Victoria research medal to Prof. W. M. Ramsay, who has been working at ancient geography for many years, and is an acknowledged authority in that branch of study; the Murchison award to Major H. R. Davis, for his explorations in the Shan States, Kachin Hills, Yun-nan, Siam, and Sechuan; the Gill memorial to Major A. St. Hill Gibbons, for the exploring and survey work which he has done in Barotseland on his two expeditions in 1895–6 and in 1898–1900; the Cuthbert Peek fund to Major H. H. Austin, C.M.G., for his exploration in the Lake Rudolf region, the Sobat region, and his expedition from Omdurman to Mombasa *viâ* Lake Rudolf in 1900 and 1901; and the Back bequest to Major R. G. T. Bright, C.M.G., for his exploring work in the Sudan, Uganda, and East Africa.

In vol. vii., article v., of the Bulletin of the Illinois State Laboratory, Mr. F. Smith continues his notes on North American oligochæte worms, dealing in this instance with a species of Lumbriculus.

The report of the Australian Museum, Sydney, for the year ending June, 1905, is before us. The most important addition during the year is a collection of ethnological specimens from North Queensland made by Dr. W. A. Roth, protector of aborigines for that district.

In contrasting different statements as to the purpose and function of museums, the March issue of *Museum News* (Brooklyn, N.Y.) takes occasion to rebuke the "Century Dictionary" for employing the word "curiosities" in this connection, the accumulation of "curiosities" being exactly what every curator who knows his business does his best to avoid.

The thirty-fourth number of the publications (they have no general title) of the Bureau of Government Laboratories at Manila is devoted to an account of birds from Mindoro and the adjacent islets, and to notes on three birds of rare occurrence in Luzon, one of these latter being the bittern. The first paper, which is well illustrated, contains descriptions of several new species, among them being a needle-tailed swift.

A fuller account of the Black Hills beetle (*Dendroctonus ponderosae*), a scolytid infesting pine-trees in the Black Hills of South Dakota and elsewhere, described by the author some time ago, is given by Dr. A. D. Hopkins in Entomological Bulletin No. 56 of the U.S. Department of Agriculture. The serious nature of the damage caused by this beetle is indicated by the statement that between 700 and 1000 million cubic feet of timber have been destroyed by it in the Black Hills Forest Reserve alone.

The third part of the *Bergen's Museum Aarbog* for 1905, of which we have received a copy, contains a long and fully illustrated paper by Mr. O. J. Lie-Pettersen on the marine rotifers of Norway, the result of investigations commenced in the summer of 1900, and a second by Mr. H. Brock on Norwegian medusas. The two last papers in this part are devoted to archæological subjects. We have also received a copy of the *Aarsberetning* of the same institution, containing the director's report of progress for the past year.

Part iii. of the third volume of the Transactions of the Hull Scientific and Field Naturalists' Club shows careful attention on the part of that body to local subjects. The first article, for instance, deals with the natural aspects of Hull and its neighbourhood; and others are devoted to the East Riding Mycetozoa, local diatoms, and reclaimed lands of the Humber district. Two local celebrities are accorded biographical notices, with portraits, while the editor, Mr. T. Sheppard, discusses the position of the Hull Museum as regards education.

The papers in the March *Zoologist* comprise one on the birds of the Færöes, and a second on those of Anglesey; while in a third Mr. R. Warren records a change in the habits of herrings visiting Killala Bay, county Mayo. It appears that since 1899 the fish, which used to keep to the bay, have taken, for about three weeks in the autumn, to entering the estuary and tidal part of the river. So close have they on some occasions come in-shore that scores may be taken with a landing-net.

The contents of the first part of vol. lxxxi. of the *Zeitschrift für wissenschaftliche Zoologie* comprise one paper by Mr. W. Schimkewitsch, of St. Petersburg, on the developmental history of the arachnid *Thelyphonus caudatus*, and its comparison with that of other members of the same group. In a second paper Mr. R. Meyer discusses the histology of the nervous system of the common starfish, *Asterias rubens*, while in the third Mr. O. Kohlmeyer describes the elastic tissue in the mucous membrane of the palate of the brown rat, the distribution of which has never previously been worked out.

An extinct volcano in Arizona and its crater form the subject of a paper by Mr. D. M. Barbinger in the issue of the Proceedings of the Philadelphia Academy for December last. One of the most remarkable features connected with this mountain is the presence of an enormous mass of meteoric iron. As the result of his investigations, the author comes to the conclusion that a huge meteor, of which at least the outer coat was metallic, fell to the earth in this locality, and that its size was so great that portions of it were fused and detached. Further, a large hole in the adjacent strata was made by the fall of the meteor.

Dr. W. J. Holland has sent us a paper on the osteology of the American dinosaur Diplodocus, with special reference to the model of the skeleton presented by Mr. Carnegie to the Natural History Museum, and installed by Dr. Holland himself. In this paper, which forms No. 6 of the second volume of the Memoirs of the Carnegie Museum, the author directs attention to the pose in which the skeleton has been mounted, explaining that, in his opinion, the peculiar structure of the occipital region renders the angle which the skull forms with the vertebral column a matter of necessity. Dr. Holland finds himself unable to accept Baron Nopsca's interpretation of the nature of the problematical bone which has been regarded as a clavicle.

The black locust tree (*Robinia pseudo acacia*) is such a familiar inhabitant of railway banks, especially in parts of France, that we read with interest Dr. Charles A. White's account, in the *Popular Science Monthly* for

March, on the troubles which have beset attempts to establish it in similar situations in America, especially in Pennsylvania. The wood of the tree is excellently suited for making fence posts and railroad ties, but, unfortunately, as soon as the stems attain a sufficient size to be of use they are liable to be destroyed by the burrowing larvæ of a longicorn beetle (*Cyllene robiniae*); and so persistent is this beetle in its attacks, that Dr. White considers the further planting of these trees to be sheer waste of labour and money.

The second number of the *Bio-Chemical Journal* contains four papers of considerable interest, and if the present standard be maintained we predict a long and useful "life" for this new publication. Mr. Leonard Hill discusses filtration as a possible mechanism in the living organism, and concludes that it does not occur under natural conditions; Mr. G. S. Haynes, writing on the pharmacological action of digitalis, strophanthus, and squill on the heart, considers that it is essential that these drugs should be standardised, as the amounts of active constituents vary much. He finds that strophanthus is 8 to 10 times as toxic as digitalis, and that squill is an excellent cardiac stimulant. Dr. Roaf and Mr. Whitley contribute a paper on the action of acids, alkalies, and salts on the tadpole; and Dr. MacLean details observations on the Fehling test for dextrose in urine, proving that creatinin is the cause of the masking of the sugar reaction which sometimes occurs in urine-testing.

A brief description appears in the Journal of the Royal Microscopical Society (February) of a newly discovered synangium that, as the writer, Mr. D. M. S. Watson, states, would two years ago certainly have been regarded as the fructification of a marattiaceous fern. The synangium consists of from four to seven sporangia grouped round a central receptacle that is hollowed out into a cup at the top, thus bearing considerable resemblance to the sporangia of the recent fern Kaulfussia and of the fossil species *Ptychocarpus unitus*. Having regard to Mr. Kidston's discovery that the synangium of Crossotheca, formerly considered to be that of a marattiaceous fern, was the male fructification of Lyginodendron, Mr. Watson leaves it open whether the new species, *Cyathotrachus altus*, should be placed in the ferns or cycadofilices.

In connection with the work of the instructors in horticulture that have been appointed by certain county councils in Ireland, it has been found that there is need of a scientific journal that will help to supply the knowledge required by small farmers and occupiers of holdings. To meet this want a new monthly publication, *Irish Gardening*, has been started, the first number having been issued this month. After a short note of encouragement from Sir Horace Plunkett, Mr. F. W. Moore provides an appropriate article on the present condition of horticulture in Ireland. The use and value of horticultural demonstration plots is discussed by Mr. J. G. Toner, and a trite comparison of English and Irish potatoes is contributed by Prof. J. Wilson in which, while upholding the quality of the Irish potato, he suggests that there is scope for new Irish varieties. Judging from these articles and the numerous notes on various topics, the new journal promises to fulfil its purpose of directing attention to the scientific principles that underlie good garden practice.

The discussion on "The Origin of Gymnosperms" at the Linnean Society, arranged for the meeting on March 15, drew a very large audience. Prof. F. W. Oliver, in opening the discussion, referred to the generally accepted view that the line of descent of the gymnosperms had proceeded through the ferns and cycads, this view being supported by the discovery of multiciliate spermatozoids in Ginkgo and in cycads, and by the recognition of the fossil group of cycadofilices. The discovery of seeds in connection with several of the Palæozoic "ferns" had led to their transference to a new and rapidly increasing group of pteridosperms. If the Palæozoic were an "age of pteridosperms" rather than an "age of ferns," was the filicinean origin of the gymnosperms weakened, and should a lycopodiaceous origin be sought? Personally, he favoured a derivation of the pteridosperms and eventually the cycads and Cordaiteæ from the ferns. Mr. E. A. N. Arber, dealing with the earlier geological records of the true ferns, also expressed his adherence to the fern-cycad line of descent. He instanced the Botryopterideæ as true ferns existing in the Carboniferous and Permian ages, and pointed out that the connection of gymnosperms and ferns must have been far back in the Palæozoic epoch. Prof. A. C. Seward, while accepting the filicinean origin for the cycads, dissented from the view that the conifers followed the same line of descent. His recent investigations of the Araucarieæ pointed to their being a very ancient group of gymnosperms, and for them, if not for conifers generally, he considered a lycopodiaceous derivation as the more probable. Owing to the late hour, Dr. D. H. Scott was unable to give his address, as announced, so the proceedings were postponed to the meeting fixed for May 3, when an opportunity will be afforded for other members to take part in the discussion.

The work of the expedition dispatched by the Smithsonian Institution of Washington to the Canadian Rockies and Selkirks, under the direction of Prof. W. H. Sherzer, of the Michigan State Normal School, is described in the report of the late Dr. S. P. Langley for the year ending June 30, 1905. The expedition had a successful season's work on the glaciers along the line of the Canadian Pacific Railway. A selection was made of those five glaciers which are most accessible to the student of glacial geology, and these were found to exhibit the characteristics of glaciers throughout the world. Four or five days of comfortable railway travel places an investigator in the midst of snow-fields rivalling those of Switzerland, and the ice bodies descending from these fields may be studied from modern hotels as a base, and a horse may be ridden to the feet of the glaciers studied by the expedition. So far as is known, there is in this district the most magnificent development of glaciers of the Alpine type on the American continent, and the purpose of the survey was to gather as much information as possible concerning them. Many photographs illustrating the details of glacial structure were obtained, and a full report of the expedition may be expected later.

We have received a copy of the results of the meteorological observations made at stations under the control of the Deutsche Seewarte for the year 1904. These observations include those made at ten stations of the second order, at which readings are taken three times daily; at four of these stations, viz. Hamburg, Wustrow, Memel, and Borkum, hourly values and means obtained from self-recording instruments are given in addition. For all days on which stormy weather was experienced on the German coasts, observations for several times a day are published from those of the fifty-six storm signal stations affected. This valuable publication forms one of the series of "Meteorological Year-books" issued by the various organisations

of the German Empire; these are all identical in form, the plan of which is practically that adopted by the International Meteorological Congress at Rome in 1879, and leaves nothing to be desired. With the exception of an occasional improvement, such as the reduction of the old anemometrical factor, which assumed that the velocity of the wind was three times as great as the velocity of the cups of the instrument, and the addition of a table showing for each station the difference between local time and mid-European time adopted in Germany in April, 1893, there has been practically no change in the contents of publication for many years. This continuity of form is a great advantage, and considerably enhances the value of the work.

We have received from the director of the Vatican Observatory, Sig. P. Angelo Rodriguez, O.S.A., vol. vii. of the *Pubblicazioni della Specola Vaticana* (Tipografia Vaticana, Rome, 1905). In these pages we first have the individual daily meteorological observations made during the years 1902 to 1904, both years inclusive. These are graphically plotted in three tables which are given at the end of the volume. Sig. Mg. Alfredo Tonetti contributes a valuable study of the cloud observations made during the years 1891–6, and this is followed by two appendices, which include observations of meteors for the years 1891 to 1896, and the mean monthly values of cloudiness for the same period. Among other sections of interest may be mentioned a brief discussion of the exceptional high temperatures recorded in July and August of the year 1904, comparison data being added commencing in 1890. Sunspot observations are also dealt with, and, in addition to the individual daily observations, a summary for each year, commencing with 1896, is added. Special reference is made to the large spot of February, 1905, and a reproduction (original size) of the solar disc for February 7 is added, the original photographic image measuring nearly eleven inches in diameter.

In the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part v.), Mr. W. A. Ker publishes a suggestive paper on some common errors in the use of electric motors for machine driving. In it he gives a list of common machines, with the types of motors which he considers most suitable for them.

Attention is directed in the *Engineering and Mining Journal* (vol. lxxxi., No. 10) to the very low cost of ore dressing which has been attained at the mill of the Osceola Copper Mine, Lake Superior. The average cost per ton of rock stamped in 1905 was only $8\frac{1}{2}d.$, as against $9d.$ in 1904. These extraordinary figures were obtained in the treatment of a million tons of rock per annum, all the ore passed through the mill having been crushed to go through a $\frac{1}{4}$-inch to 3/16-inch round hole.

The locomotive industry is dealt with in an exhaustive paper by Mr. L. Le Chatelier in the *Bulletin de la Société d'Encouragement* (vol. cviii., No. 2). Beginning with Trevithick's locomotive of 1803, he illustrates the leading types, and expresses the opinion that the works of the Hanover Engineering Company represent the most perfect example of the international locomotive industry. The Crewe works, with their 7500 workmen and their annual output of seventy-five locomotives, are referred to by the author in terms of warm admiration.

"Economic Studies in Italy" form the subject of a letter by Prof. Achille Loria in the *Economic Journal* for March. A noteworthy feature of Italian economics is the absence of any scientific treatment of socialistic problems.

In the Bulletin of the Belgian Royal Academy (1905, xi.), the death is announced of the oldest member, M. Gustave Davalque, who was elected associate in 1854 and member in 1859, and drew up reports on mineralogy for the society subsequent to 1872.

Prof. Luigi Berzolari contributes to the *Rendiconti* of the Lombardy Institution an interesting account, extending to more than sixty pages, of the work of the late Prof. Luigi Cremona. A list of previous biographical notices is given in a footnote.

Prof. G. Cesàro, of Liége, describes in the Bulletin of the Belgian Academy, x., a new method of proving geometrically the principal formulæ of spherical trigonometry, notably Lhuilier's and Euler's formulæ, Napier's and Delambre's analogies, and the expressions for the radii of the circles of a triangle.

Mr. H. M. Taylor, F.R.S., has published in the *Messenger of Mathematics*, No. 414, a collection of geometrical dissections, in which it is shown how to transform figures from one shape into another by division into a definite number of parts and re-arrangement of the parts. While these constructions afford a highly interesting study, it may be desirable to point out that if it be required, for example, to convert a rectangle into a square of equal area by this method, the construction presupposes a knowledge of the side of the required square.

In the Bulletin of the American Mathematical Society for January Prof. Jacques Hadamard gives a review in French of the late Prof. Willard Gibbs's "Elements of Statistical Mechanics," which appeared in 1902. Based as the review is on a detailed study of Gibbs's work and of criticisms thereon, the notice forms in some respects an innovation in reviewing which might with advantage be followed on other occasions in connection with mathematical works. It is certain that the book in question contained many features that could only be properly judged after long and minute study.

In a paper reprinted from the *Abhandlungen* of the Royal Academy of Saxony, xxix., 4, Dr. Otto Fischer discusses the dynamics of the motion of a system of bodies jointed together and moving in space. An illustration of such jointed systems is afforded by the limbs of animals. In general, a system of n jointed bodies has $3n+3$ degrees of freedom, but there are many cases in which the number is less, and the author shows how the equations can be simplified by replacing the system by a dynamically equivalent set of particles or "reduced system."

Under the title "Abhandlung zur Didaktik und Philosophie der Naturwissenschaft," Messrs. Julius Springer, of Berlin, are issuing a series of pamphlets, in the form of monograph supplements to the *Zeitschrift fur den physikalischen und chemischen Unterricht*. The object of these pamphlets is to give expositions of various points connected with the teaching of the sciences in question. No. 5 of the series is by Prof. Hans Keferstein, of Hamburg, and contains an exposition of the elementary properties of lenses and optical combinations treated from an experimental point of view. In the introduction the author points out that two of the various branches of physics, mechanics and optics, are made to assume a more mathematical aspect than the rest, the former by introducing the concept of particles, which reduces the study to that of certain systems of *points*, the latter by the concept of rays, leading to the study of certain systems of *lines*. The

present pamphlet treats exclusively of the magnifications produced by lenses, the paths of the rays, and the principles of the microscope and telescope.

The danger which may accompany the teaching of elementary chemistry to children has been sadly illustrated by the death of a girl of fifteen years of age—a pupil at the Plymouth Secondary School—caused by swallowing a strong solution of caustic soda while working in a practical chemistry class. The coroner's inquest showed that the child—one of a class of eight—misinterpreted the directions given by the instructor, and sucked into a pipette a concentrated solution of the alkali without previously diluting it, as she had been told to do; in doing this she managed to swallow some of the solution. In view of the fact that three other pupils out of the eight in the class gave evidence showing that they also had not followed the directions given, it is clear that, in order to guard against such accidents, the experiments should be devised in such a way that, in the event of a misunderstanding, no evil results may accrue. In the present case, for instance, in which the neutralisation of sulphuric acid by caustic soda was being studied, the concentrated solutions might have been diluted by the demonstrator in front of the class, and the diluted solutions thus prepared then have been used for the pupils' measurements. Other simple expedients could readily be suggested in which the use of an ordinary pipette is avoided. In the practical study of chemistry there are many possibilities of accident, and this should be borne in mind by the examining and inspecting authorities which prescribe the work to be done in school laboratories, and by the teachers who devise experiments for their pupils. It should be unnecessary to add that the instructor, particularly when he has to deal with children, should not only have seen chemical experiments performed, but have acquired by a prolonged course of laboratory work a real knowledge of manipulation and of the dangers likely to be incurred in any case.

Messrs. John J. Griffin and Sons, Ltd., have issued a third edition of their well illustrated list of apparatus for electrochemistry, arranged for students working through Dr. Lüpke's "Grundzüge der Electrochemie."

A popular article, with several striking illustrations, upon the eye-spots exhibited by various creatures as ornaments or for protective purposes appears in the April number of *Pearson's Magazine*.

The current issue of the *Home Counties Magazine* contains, among other interesting matter, a reprint of a lecture by Mr. M. J. C. Meiklejohn on the place-names of Northwood and district, and the first of a series of articles in which the editor, Mr. W. Paley Baildon, has collected all available references to Paul's Cross, and arranged them in chronological order.

The current number of *Past and Present*, the successor to the *Natural History Journal*, published in connection with the Friends' Schools, is before us. The magazine shows that great encouragement is given in these schools to observational science, and that the boys are in the habit of making and recording outdoor observations in biological and meteorological science. The illustrations of the school buildings are proof enough that the claims of science are not forgotten in the school curriculum.

Several parts of volumes of Transactions of the Royal Society of Edinburgh, containing papers read before the society during the sessions 1902–3, 1903–4, and 1904–5, have just been received; and also vol. xliii. of the Transactions, edited by Dr. A. Buchan, F.R.S., and Mr. R. T. Omond, devoted to the Ben Nevis observations during the years 1893–7. As abstracts of the papers read before the society appear periodically among our reports of meetings, it is unnecessary to refer again to the many important contributions now printed in full in the Transactions recently issued.

The fifth part of vol. ii. of the Proceedings of the University of Durham Philosophical Society has been received. The number contains five papers read before the society between February 9 and April 27, 1905, together with the proceedings for the academic year 1904–5. Prof. H. Stroud contributes a paper on spark-gap experiments for detecting radio-activity, Dr. J. A. Smythe a note on a contact rock from the Island of Mull, Mr. A. Brennan notes on abnormal flowers of *Lilium Martagon* (Linn.), Dr. D. Woolacott a paper on the pre-Glacial "wash" of the Northumberland and Durham coalfield, and Mr. G. Thomson one on the effect of light on selenium.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in April:—

April 5. 5h. 48m. to 6h. 42m. Moon occults α Leonis (Regulus, mag. 1·3).
6. 7h. 3m to 7h. 57m. Moon occults χ Leonis (mag. 4·7).
,, 15h. 50m. to 16h. 19m. Moon occults σ Leonis (mag. 4·1).
11. 11h. 30m. Minimum of Algol (β Persei).
14. 8h. 19m. ,, ,, ,,
15. Venus. Illuminated portion of disc = 0·967. Of Mars = 0·978.
16. 15h 48m. to 16h. 29m. Moon occults θ Capricorni (mag. 4·2).
18. 23h. Saturn in conjunction with Moon. Saturn 0° 22′ N.
24. 8h. 22m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
,, 15h. Venus in conjunction with Moon. Venus 5° 11′ N.
26. 4h. Jupiter in conjunction with Moon. Jupiter 4° 16′ N.
,, 5h. 42m. Near approach of Moon to α Tauri (Aldebaran).
27. 8h. 51m. to 9h. 48m. Moon occults 119 Tauri (mag. 4·6).
30. 11h. 33m. to 12h. 28m. Moon occults ζ Cancri (mag. 4·7).

Comet 1906*b*.—A part of the ephemeris for comet 1906*b* (Kopff), calculated by Herr M. Ebell and published in No. 4080 of the *Astronomische Nachrichten*, is given below:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log r	log Δ	Brightness
April 6	11 22 53	2 24	0·5355	0·3983	0·81
14	11 21 18	2 28	0·5397	0·4128	0·74
22	11 20 38	2 26	0·5440	0·4291	0·67
30	11 20 58	2 20	0·5484	0·4468	0·61

Unit brightness on March 3 = about mag. 11·0.

This comet is still in the constellation Leo, near to the star τ, which is on the meridian at about 11 p.m.

The suggestion that this object was a periodic comet of short period is not confirmed by the observations.

Observing at Strassburg on March 17, Dr. Wirtz recorded that the comet had a nucleus of mag. 11·5, the total magnitude being 11·0. The nebulosity was only 0′·7 in diameter, and appeared to be extended towards position angle 270°.

Comet 1905*c*.—The following is an extract from Herr Wedemeyer's ephemeris for comet 1905*c* (Giacobini) as published in the supplement to No. 4080 of the *Astronomische Nachrichten*:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) ° ′	log *r*	log Δ	Brightness
April 5	3 36 46	+ 8 12	0·2390	0·3763	0·20
9	3 45 22	+ 9 8	0·2559	0·3943	0·17
13	3 53 33	+ 9 59	0·2718	0·4114	0·15
17	4 1 22	+ 10 46	0·2870	0·4275	0·13
21	4 8 53	+ 11 28	0·3014	0·4428	0·11

An observation at Strassburg on March 17 gave corrections of −11s. and −3′·9 to this ephemeris. The comet was pale, with no certain nucleus, and the ill-defined nebulosity was about 2′ in diameter; total magnitude about 11·5.

This faint object is now apparently traversing the constellation Taurus towards the Pleiades, and will be some 3° south of that asterism on April 23. It sets, a little to the N. of W., at about 9 p.m.

A Systematic Study of Faint Stars.—Apropos of Prof. Kapteyn's plan for studying faint stars, Prof. Pickering gives a detailed account of how similar work is being performed at Harvard College Observatory in *Circular* No. 108.

It is impossible to describe the whole work here, but both photometric and photographic methods are being employed, and by using the two 24-inch reflectors Prof. Pickering hopes to extend the survey to stars fainter than Phœbe.

In studying the spectra, the 8-inch Draper and Bache telescopes have been employed, and stars down to the eleventh magnitude have been observed successfully. Using the 24-inch reflectors, Prof. Pickering hopes to photograph the spectra of much fainter stars.

By following the stars precisely, so that the resulting spectrum is merely a line, thirteenth magnitude stars have been dealt with, and, on a photograph obtained with the 8-inch Draper telescope, the spectrum of a star of mag. 13·3 is sufficiently clear to be classified; the same plate shows the spectra of 110 stars within 1° of the North Pole.

Stars having Peculiar Spectra.—In *Circular* No. 111 of the Harvard College Observatory, Prof. Pickering gives a list and details of twenty-four stars which, from a study of the Henry Draper memorial photographs, Mrs. Fleming has found to have "peculiar" spectra.

One or two of the objects call for special remark. The star D.M. +21° 1609 is identical with N.G.C. 2392, which was found to have a continuous spectrum, with three bright lines, by Wenlock and Peirce on January 7, 1869. D'Arrest, also, found it to be gaseous. Photographs taken at Harvard on November 21, 1900, and November 27, 1905, show no traces of the bright lines characteristic of gaseous nebulæ, but that its spectrum is of the fourth type. This star is in Gemini, its approximate right ascension and declination (for 1900) being 7h. 23·3m. and +21° 7′ respectively.

In the spectrum of the star D.M. +36° 3907 the hydrogen line Hβ appears as a fine bright line centrally superposed on a dark line, on photographs taken on July 4 and November 4, 1905.

A spectrogram of the variable star R Cygni, obtained on November 19, 1890, showed the hydrogen lines Hγ and Hδ bright, but a photograph taken on December 7, 1904, with the same instrument, shows a spectrum of the fourth type containing no trace of bright hydrogen lines.

The Lunar Eclipse of February 8.—The total eclipse of the moon which took place on February 8 this year was fully observed at the Goodsell Observatory, Northfield, Minn. (U.S.A.), and an account of the observations is given in No. 3, vol. xiv., of *Popular Astronomy*.

Dr. Wilson especially remarks on the brightness of the eclipsed moon, and on the remarkable contrasts of colour seen on the darkened surface.

Five photographs were secured, and the last one, taken with a small camera attached to the telescope, exposure 5m., shows the details of the lunar surface and its unequal colouring very plainly.

Similar observations were made by M. Quénisset at the Nanterre Observatory, and four of his photographs are reproduced in the March number of the *Bulletin de la Société astronomique de France*. He records the shadow as "very transparent."

PARALLEL RUNNING OF ALTERNATE CURRENT GENERATORS.

The *Bulletin des Séances de la Société française de Physique* for the second quarter of last year contains an interesting article by M. Boucherot on the general principles which enter into the design and construction of alternating current generators.

After a brief description of the present methods of construction, the author passes on to consider, first, the wave form; secondly, the regulation; thirdly, parallel running; and, finally, methods of compounding.

The most important part of the article is that devoted to the question of parallel running, and, although the mathematical treatment is not very clearly explained, the conclusions arrived at are interesting.

The question is considered under two headings. In each the subject of inquiry is the influence of the fly-wheel, or the fly-wheel effect of the rotating parts, on the oscillations about a state of uniform angular velocity; but under the first heading the oscillations are caused by the variations of turning effort of the prime mover during a single revolution, and under the second heading the oscillations are produced by the action of the engine governor.

In dealing with the first of these there are two quantities which are of prime importance in the calculations viz. the energy stored in the rotating parts, $W(=\frac{1}{2}J\Omega^2)$, and the elastic couple or restoring force, C_s, which is defined as the couple which tends to restore the rotating parts to phase coincidence with the network to which the armature is connected, when the deviation is one radian. Then it is shown that the natural period of the system is $2\pi\sqrt{J/C_s}$, and the restoring force $C_s = C_N pk$, where C_N is the full load torque, p the number of pairs of poles, and k the ratio of the short-circuit current to the normal current.

Next, the analysis of the turning moment is given for single-cylinder and for multiple-cylinder engines as follows:—

	Order of harmonic	Half load	Full load
Single cylinder	1	0·12	0·14
,, ,,	2	0·9	0·9
,, ,,	3	0·12	0·11
,, ,,	4	0·4	0·11
Multiple cylinder	1	0·1	0·1
,, ,,	2	0·5	0·2
,, ,,	3	0·35	0·15
,, ,,	4	0·4	0·4

the mean constant turning moment being reckoned as unity.

Each harmonic produces its own oscillation in the rotating system, the amplitude of which is proportional to the value of the harmonic multiplied by $\frac{1/2n^2}{W-W_n}$ (not $W/W-W_n$ as stated in the original), where n is the order of the harmonic and $W_n = C_s\, 2n^2$. If the total fly-wheel effect happens to be such that $W=W_n$, resonance will occur, and this expression will enable the designer to proportion the rotating parts so as to avoid serious trouble.

More interesting is that part of the article devoted to the effect of the engine governor on parallel running and hunting. The subject is confessedly a difficult one, and at present there is no accepted theory. The suggestion put forward by the author is somewhat compressed and difficult to follow; and, even so, only the chief points of the argument can be mentioned here.

The generating set with its governor is treated as being composed of two interdependent oscillating systems, each with its own natural period and its own coefficient of damping. In addition to these four quantities, two others are of great importance, viz. K, the percentage variation of speed between no load and full load, and T_a, the time lag of the governor. The latter quantity is defined as the time which elapses between the governor reaching its extreme position and the turning moment of the engine taking up its corresponding value. This time lag is greater in compound and triple expansion than in simple engines, due to the passage of the steam through the cylinders.

Considering, first, the case of a generating set connected to an external network assumed to be of infinite capacity, it

is shown that the periodicity of the oscillation is given by the equation

$$\tan(\alpha . T_d) = 1/2m(\alpha_r/\alpha - \alpha/\alpha_r),$$

where $2\pi/\alpha$ is the period of the oscillations produced, $2\pi/\alpha_r$ is the natural period of the governor, and m is the

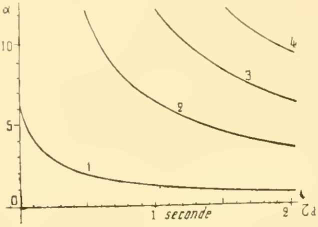


Fig. 1.

ratio of the actual damping of the governor to the smallest value of the same coefficient which makes the governor dead beat.

This equation of α in terms of T_d represents a series of curves, some of which give rise to negative values. The positive values corresponding to $m=1$ and $\alpha_r=6{\cdot}32$ are

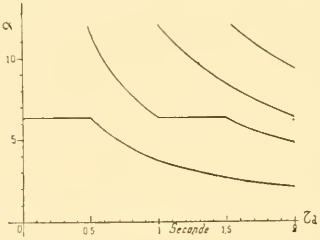


Fig. 2.

shown in Fig. 1. Of these curves, only the lowest one represents oscillations which are not evanescent.

For this case the conclusion is reached that for satisfactory running the percentage variation of speed K must not be too small, and the fly-wheel effect must be designed in proportion to the time lag of the governor.

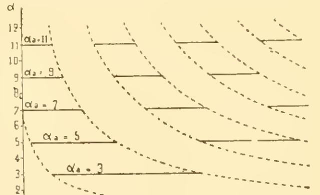


Fig. 3.

Passing to the case where two sets are working in parallel, the equation giving the frequency of the oscillations is similar to the above, provided the damping in the generators is small. In this case, however, the curves which give positive values of α are quite different, being as shown in Fig. 2. The straight line portions correspond to $\alpha=\alpha_a$, where $2\pi/\alpha_a$ is the natural period of the alternator.

Now the rate of subsidence of any oscillation contains a term $(1-\alpha/\alpha_a)$, and it is consequently clear that it would be unsafe to allow any value of T_d between 0 and 0·5, or between 1 and 1·5, as shown in the figure. If, however, the damping of the governor is much greater than the critical dead-beat value, satisfactory working may be possible.

A point of great interest is brought out in this connection, viz. the influence of the fly-wheel effect. The straight portions of the curves in Fig. 2 depend upon the natural period of the alternator, which in turn depends upon the fly-wheel. The heavier the fly-wheel the less the value of α_a, and consequently the longer the straight portion of the curve as shown in Fig. 3. In other words, the greater the fly-wheel effect the greater will be the range of T_d for which satisfactory working is difficult. From this it would appear that it is quite possible to provide too heavy a fly-wheel.

The article concludes with a brief reference to the various methods of compounding alternators.

GEOLOGICAL NOTES.

In the *Zeitschrift der Gesellschaft fur Erdkunde zu Berlin* (1905, p. 412) Prof. Dr. A. Phillipson, of Bern, outlines his recent journey of 10,000 kilometres through the west of Asia Minor, including Brussa, near the Sea of Marmora, and Makri, on its Mediterranean inlet in the south. The preliminary results indicate the existence of a "Lydian mass" of granite, gneiss, and crystalline schists, which forms on the whole a hummocky country, flattening itself out where the lower course of the Mæander cuts into it. The inhabitants are mostly clustered along the included basins of Neogene deposits. A zone of metamorphic limestones and less altered phyllites lies outside this mass, following the strike of the bow-shaped crystalline core; and the discovery of a new species of Fusulina (p. 417) places part of this outer zone as Permo-Carboniferous. To the south and south-east, the Cainozoic earth-movements have brought up folded limestones of the Cretaceous and Eocene type of Greece and Rhodes. The complete results of the journey will not be worked out for several years.

Dr. G. Steinmann continues, in the *Berichte der naturforschenden Gesellschaft zu Freiburg-im-Breisgau* for September, 1905, his "Geologische Beobachtungen in den Alpen." The question of Klippen-structure and overfolding in the classical Alps of Glarus leads on to a comparison with the eastern Alps. The author gives a valuable exposition of Schardt's views, which were published in 1893, and which led to the conception of the breaking up of an overthrust limestone mass into blocks or "klippen," which lie discordantly among later sediments. Without going so far as Termier (p. 32), Dr. Steinmann sees in this striking theory of overfolding the true explanation of the phenomena of the Bündnerschiefer and the limestone zone, and he appeals to workers in the eastern Alps to consider Schardt's views at least in the light of a scientific possibility. The last part of the present paper includes a bold but reasonable speculation as to the connection between deep-sea radiolarian deposits and diabasic igneous rocks. It is suggested, for the Alpine, Scotch, and other instances, that these basic igneous masses accumulated under the ocean-floors, just as more highly silicated rocks are believed to gather under continents. Consequently, a deep-sea epoch, followed by one of compression and overthrusting, would lead to a squeezing out of "ophiolitic" igneous rocks somewhere along the zone of the radiolarian cherts.

The activity of geological research in the African colonies is evidenced by a recent part of the *Transactions of the Geological Society of South Africa*, published in Johannesburg in September, 1905. Mr. A. L. Hall describes (p. 47) the mode of occurrence of the tin-ore in the picturesque Bushveld area forty miles north-east of Pretoria. The ore was first noticed in the local granite as recently as 1904, and the field was described by H. Merensky in that year. Its exploitation at once followed, and Mr.

Hall has been able to examine the rocks traversed by the new shafts and drives. The field was extended, while his paper was in preparation, by a further discovery on the farm Vlaklaagte. In this case there is evidence of the deposition of the cassiterite in good crystals, of the size of coarse shot, throughout a granitoid rock, which is of later age than the surrounding red granite. Minerals containing fluorine, topaz being among them, are already known in the Bushveld igneous series, and hence there is reason to believe that the tin-ore may have been developed on Enkeldorn and Vlaklaagte in the manner recognised in the "classical stanniferous localities."

Mr. H. Kynaston appropriately describes (*ibid.*, p. 61) rocks allied to greisen, from a point much further north, in the Olifants River Valley. He also adds to our knowledge of the norites and schists associated with the Bushveld granite, perhaps as marginal phenomena. Dr. Molengraaff, whom we regard almost as a veteran in these years of rapid exploration, and as the founder of much of our knowledge of the Transvaal, further supports his view (*ibid.*, p. 63) that the Pretoria series may be correlated with the jasper beds of Griqualand West. He now describes Mr. Leslie's discovery of crocidolite in the ferruginous quartzites of the Pretoria series in the Lydenburg district. These beds overlie the well known dolomite, which thus may be paralleled with the Campbell Rand dolomite of the south. Dr. Molengraaff's account of contact-altered rocks in the Pretoria series should fit in with Mr. Kynaston's observations further north; and the conferences of the Geological Society of South Africa will doubtless show how much of the extensive alteration is due to the granite and felsite series, and how much to the sheets of norite. The present tendency, however, seems to be towards the linking of these two types of intrusive rock in a continuous series.

Mr. Thord-Gray (*ibid.*, p. 66) describes in some detail the occurrences of gold in the Pretoria series round Pilgrim's Rest (Lydenburg gold-field), and concludes in favour of the view that a mineral infiltration, carrying both gold and copper, took place along certain zones of the conformably bedded series. The horizontal "reefs" may thus be described as altered quartzites.

The correlation of the members of the Transvaal system is again taken up by Prof. Schwarz, who attacks the problem in the north of Cape Colony, in Prieska. He has, quite independently, reached the same conclusions as Dr. Molengraaff, and, with certain cautious reservations, passes his comprehensive eye over similar beds in India and North America also. The extraordinary uniformity of deposits in South Africa across enormous areas certainly gives one a new faith in lithological stratigraphy; and it is on this ground that Prof. Schwarz wishes to bring together the two series of ferruginous jaspers in the southern part of the Transvaal, calling in a thrust-plane to his assistance. The general feeling will be, both in our islands and in the Transvaal, that detailed mapping will ultimately bring a just correlation in its train. But detailed geological mapping requires good topographic maps, and the limited resources of the colony seem just now, from a legislator's point of view, to have many prior claims upon them.

Mr. F. P. Mennell shares with the equally energetic Mr. A. J. C. Molyneux the task of elucidating the geological problems of Rhodesia, a region about as large as France, Germany, Austria-Hungary, and Italy put together. The gold problem is naturally the first thing to be investigated, and Mr. Mennell (*ibid.*, p. 82) seeks to correlate the Rhodesian "banket," which he shows to be a true conglomerate, with the gold-bearing series of the Rand at Johannesburg. "So far," however, "it is only at the Eldorado Mine, in the Lomagundi district, that gold has been proved to exist in payable quantities" in the banket of Rhodesia. As Prof. J. W. Gregory recently informed us, other deposits or vein-stuffs may have become known as banket, and it is certainly wise to restrict this term, of Transvaal origin, to the quartzose conglomerates, wherever they occur. In Rhodesia, Mr. Mennell has to deal with a metamorphosed series of sediments, including these conglomerates, and penetrated by ancient and now schistose basic rocks. The widely occurring granite is later than the basic intrusions, and has produced considerable contact-alteration in the entire series. The gold, in accordance with the view now prevalent for the Rand deposits also, is regarded as a subsequent infiltration.

Part ii. of vol. xxxii. of the *Records of the Geological Survey of India* contains Mr. Hayden's "Preliminary Note on the Geology of Tibet," already noticed in this Journal (Nature, vol. lxxii., p. 285), and Dr. T. H. Holland's paper on the occurrence of bauxite in India. The latter author directs further attention to the aluminous nature of the Indian laterites, and throws the whole field of these rocks open to the prospector. He points out (General Report of the Survey, *ibid.*, p. 142) that the red bauxites of Les Baux were first worked as iron-ores; and in his paper on bauxite the analyses of Indian samples are all from rocks previously known as laterites. A very interesting point is the high percentage of titanium dioxide revealed, and Dr. Holland supports Dr. R. S. Bayer in believing that some unfamiliar and possibly new substance becomes precipitated with the titanium in these cases. Dr. Holland regards bauxite as an intimate admixture of gibbsite, $Al_2O_3.3H_2O$, and diaspore, $Al_2O_3.H_2O$.

Another Indian paper is by Mr. E. W. Wetherell, on the dyke rocks of Mysore (*Mysore Geological Department Memoirs*, vol. ii.), in which a large number of specimens are conscientiously described. The descriptions suffer, however, from the fact that the species of triclinic felspar are not determined. Nor are the misprints so few as the "corrigenda" might lead one to suppose. The drawings for the plates show exceptional care and delicacy.

Mr. G. H. Girty, of the U.S. Geological Survey (*Proc. Washington Acad. of Sciences*, vol. vii., June 20, 1905, p. 1), has instituted a comparison between the Carboniferous faunas of western America and those of Russia and other areas. The ultimate result tends to the increase of the Upper Carboniferous series in America at the expense of beds now classified as Permian. The polyzoan Archimedes, moreover, is shown to possess a far wider range than would be gathered from a consideration of the typical American deposits.

Messrs. Stanton and Hatcher, assisted by Mr. Knowlton, discuss the geology and palæontology of the Judith River beds, in northern and central Montana and the adjacent parts of Canada (Bulletin 257, U.S. Geol. Survey, 1905). The outcome of stratigraphical study, and the examination of the vertebrate and plant remains, show that these beds are no longer to be regarded as on the Laramie horizon, but are Senonian at the highest, and reach down to the Cenomanian.

The same survey (Bulletin 262) issues contributions to mineralogy, by several authors. The researches on which these careful papers are based arose in connection with the general work of the survey, and the results are here conveniently brought together. Messrs. Hillebrand and Ransome discuss the nature of carnotite (p. 18), which, "instead of being the pure uranyl-potassium vanadate, is to a large extent made up of barium and calcium compounds." From this "mixture of minerals" the true carnotite remains to be extracted and defined. Messrs. Lindgren and Hillebrand (p. 48) incidentally direct attention to the optical properties of chrysocolla, which, though noticed by Jannetaz, have been very generally overlooked. Mr. Schaller (p. 115) gives us a critical analysis of dumortierite, deducing thence the formula

$$8Al_2O_3.B_2O_3.H_2O.6SiO_2.$$

The boron oxide was first indicated by R. B. Riggs in 1887. These are only a few of the matters that will attract mineralogists to these 147 pages.

The surface-features of the glaciated areas of North America have provided a wide field for description and for controversy. Mr. R. S. Tarr has sent us four papers, in which various problems are set forth. That on moraines of the Seneca and Cayuga lake valleys (*Bull. Geol. Soc. America*, vol. xvi., p. 215) is mainly descriptive. The drainage-features of central New York (*ibid.*, p. 229) involve questions of stream-capture, the lowering of water-partings, and the formation of new slopes by detrital deposits, such as delight the glacial expert. A geographical account of the gorges and waterfalls of central New York (*Bull. American Geographical Soc.*, April, 1905) is largely concerned with the relations of pre-Glacial and post-Glacial

valleys. Of still more general interest is the paper on some instances of moderate glacial erosion (*Journal of Geology*, vol. xiii., 1905, p. 160), with its examples of granite boulders lying in a sand derived from their own decay, and left undisturbed by the passage of an ice-sheet over them. The remarkable variations in the intensity of glacial erosion recorded by Dr. Ampferer from the valley of the Inn (NATURE, vol. lxxi., p. 236) might be cited in support of the author's observations.

The sixth volume of *Spelunca* is to be devoted to a review and bibliography, by M. E. A. Martel, of all papers on caves published so far in the twentieth century. The first part, issued in June, 1905, covers the papers dealing with France, and the enthusiastic author has spared no pains in making a series of complete and valuable abstracts. The result is a readable work, full of attraction for the geographer as well as the geologist, in which M. Martel devotes most of his own energies to the tracing out of the courses of underground streams.

In the *Geological Magazine* for 1905, Dr. Francis Baron Nopcsa has begun a study of the remains of British dinosaurs, preserved in the collections of the British Museum at South Kensington. He shows that some crocodilian remains are mingled in the rock with those of Polacanthus. The remarkable bony dermal armour and the general skeleton of this dinosaur are figured, and the inflexible union of the lumbar vertebræ is pointed out as a unique feature in this group. The author is, indeed, led to style Polacanthus a sort of glyptodon among dinosaurs.

G. A. J. C.

THE FORTHCOMING INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

THE sixth International Congress of Applied Chemistry, already mentioned in NATURE (this vol., pp. 322 and 421), will be opened at Rome on April 26 by H.M. the King of Italy. The work of the congress is divided into eleven sections, and in each section an extensive programme has already been organised. Many of the most eminent chemists of Europe and America have promised to attend and deliver papers. Sir Wm. Ramsay will give an address on the purification of sewage, Prof. Moissan will lecture on the distillation of metals, and Dr. A. Frank, of Berlin, on the direct utilisation of atmospheric nitrogen in the manufacture of manures and chemical products. Among the numerous papers which have been received by the committee of the congress, the following may be noticed as possessing general scientific interest:—

Section ii.—The extraction of thorium and cerium from the monazite sands, and their utilisation in Welsbach mantles, by Prof. F. Garelli and G. A. Barbieri.

Section iii. (metallurgy).—The actual state and the future of thermoelectric metallurgy, especially with regard to steel, by Major E. Stassano; report on the state of metallurgy in France, by the Comité des Forges de France.

Section vii. (agricultural chemistry).—Chemical changes during the assimilation of nitrogen by bacteria, by Dr. J. Stoklasa; the significance of the bacterial examination of soils, by Prof. Remy.

Section viii. (hygiene and medical chemistry).—The value of inulin as food in glycosuria, by Prof. C. Ulpiani; our present knowledge of the fats from the standpoint of physiological chemistry, by Dr. A. Jolles; inosuria, by Dr. Meillère.

Section x. (electrochemistry and physical chemistry).—This section is represented by more papers than any of the other sections. The following may be mentioned:—Certain cases of hydrolysis, by Prof. Veley; the van 't Hoff-Raoult formula, by Prof. W. D. Bancroft; isomorphism and solid solutions, by Prof. Bruni; electrochemistry of non-aqueous solutions, by Prof. Carrara; relations between proteids and electrolytes, by Prof. Galeotti; action of catalysts in the Deacon process for manufacturing chlorine, by Prof. G. M. Levi; silicide of carbon and the calcium carbide industry in France, by Prof. Moissan; catalysis by common metals, by Prof. Sabatier; chemistry of colloids, by Prof. Beckhold; amphoteric elements, by Prof. Le Blanc; toxins and anti-toxins, by Prof. Ehrlich; solid polyiodides of the alkali metals, by Prof. Abegg; dissociation of fused salts, fused silicates, and glasses, by Prof. Doelter.

The Italian State railways have granted to the members of the congress and their ladies a reduction of about 60 per cent. on the price of an ordinary railway ticket from the frontier to Rome. On their arrival in Rome members of the congress will receive from the committee a book of coupons, which will enable them to obtain at any station tickets at fares reduced by 40 per cent. to 60 per cent., according to the length of the journey. These tickets are available from April 26 until June 11, so that members of the congress may have the opportunity of visiting the International Exhibition at Milan. The subscription fee for membership of the congress is 20 lire for gentlemen and 15 lire for ladies. A special ladies' committee has been formed to receive foreign ladies with the purpose of making their stay in Rome as pleasant as possible.

All inquiries should be addressed to the bureau of the congress, 89 Via Panisperna, Rome

PHYSICAL CONDITION OF CHILDREN IN ELEMENTARY SCHOOLS.[1]

THE physical condition of those who are about to enter on active service in the affairs of life, and whose energy is the chief of the national assets, is certainly a matter of great national importance. Every effort is justified in producing as effective a working community as is possible, and Dr. Kerr's report affords welcome evidence of the increasing concern with which those who direct education are regarding the physical conditions of child-life.

During the period dealt with in this report a limited investigation was made of the conditions of some 3500 of the girls and boys attending the Council's schools, and very striking were the results obtained. It was found that some 42 per cent. of these possessed insufficient clothing to retain animal heat, and therefore stood in urgent need of help in this direction; it is not surprising to find that these children were below the average weight of the school for their age; 45 per cent. of those examined had dirty clothes and bodies, and about one-quarter of these were in a verminous condition; here again these children fell distinctly short of the average age weight. The above results tend to show, perhaps, no more than the fact of poverty, although the excessive shortage of weight in the worst clad class of scholars suggests that insufficiency of clothing is a definite factor in producing malnutrition, the insufficient food energy being first taxed to keep up the animal heat.

The greatest effect upon the life capital of the population is produced by the infantile mortality, which in some years actually kills off during the first year one in five of all children born; the question naturally arises, what is its effect upon the survivors? Does the adverse environment which slaughters one in five have a maiming effect upon those left? Dr. Kerr's investigations indicate that the children born in a year when infantile mortality is low show an increased physique, and those born in the years of high infantile mortality show a decreased physique. It appears, therefore, that in the years of high infantile mortality the conditions to which one in five or six of the children born are sacrificed have a maiming effect upon the other four or five.

The examination of the teeth of some 1500 school children demonstrated that, in the case of the boys, some 90 per cent. had caries, and 70 per cent. to a serious extent. Only the boys who had insufficient grinding surface were below the average in physique. It appears, therefore, that caries must be severe to produce an effect on nutrition.

As the result of an examination of the condition of the eyes, it was found that a constant number of about 10 per cent. of scholars have bad vision; and it is estimated that deafness alone is probably sufficient to interfere

[1] "Report of the Education Committee of the London County Council submitting the Report of the Medical Officer (Education) for the Year ended March 31, 1905." No. 922. (London: P. S. King and Son, 1905.) Price 1*s*., post free, 1*s*. 2*d*.

to a considerable extent with the educational instruction of at least 5 per cent. of scholars.

The necessity for increased endeavours to obtain better physique is sufficiently obvious to anyone visiting the schools, and it is satisfactory to find that the school exercises are being improved.

Dr. Kerr deals in this report with the question of the exclusion of children from school attendance between the ages of three and five years. He appears to favour the existence of the present state of things, but in this view he will probably not receive much support from medical officers of health. Doubtless school attendance affords facilities for the spread of certain communicable diseases (70 per cent. of the infants under five who are at present admitted to the Council's schools have not yet had measles or whooping-cough), and the advantage to the child of postponing attacks from these diseases for even a year or two is so great that it offers one strong argument in favour of excluding children under five from school attendance. Dr. Kerr states that children learn more in the years three to five than they will learn in the same period at any time subsequently. But in children between three and five the reasoning from what they see and hear is very slight indeed, and in the opinion of many the child does not really stand in need of school-teaching before it reaches the age of five.

Increasing solicitude is shown in regard to the personal cleanliness of the children attending the public elementary schools, and Dr. Kerr discusses some of the problems underlying the difficult question of dealing with underfed children. The nurses working under the Council are accomplishing a highly important work of considerable educational value in examining for cases of ring-worm, vermin, and unwholesomeness, and in many cases they follow up their school work by home visits. In connection with the campaign now being carried on in favour of personal cleanliness in schools, the provision of school washing-baths, as distinct from swimming arrangements, is becoming increasingly necessary in many parts of London.

The more important facts dealing with infectious disease in this report relate to the subjects of diphtheria and measles. From the result of much observation and many carefully recorded facts, Dr. Kerr concludes that when a school becomes a source of infection it is generally found that the cases of diphtheria are connected with a class or classes in which the average age of the children is between five and eight. Rarely do cases below five or above eight become sources of infection, and never has it happened in the investigations that a class the average age of which is less than four or above ten has been found to be acting as a disseminating centre. These classes appear to become sources of infection because the children at these ages have the power of partial resistance to the onslaught of diphtheria bacilli, and a large proportion of them are capable of attending school while suffering from slight attacks. Dr. Thomas, the assistant medical officer, in a valuable report upon measles and school closure, concludes that in London at present the disease only spreads in classes under five years of age, except in certain better-class districts, and that to effect any useful purpose school closure must take place before the "first crop" falls. The old practice of waiting until the attendance fell to a certain limit was useless in arresting the spread of measles, and did absolutely no good.

STUDIES OF NATIVE TRIBES.

The American ethnological work in the Philippines is making steady progress. The first part of vol. iv. of the publications has just appeared. It deals with Moro history, law, and religion. Mindanao and Sulu were conquered in the Middle Ages by Mohammedans, who established a new form of government and introduced a written code of laws. Previous to this there was no written history, but thenceforth the datus or chiefs kept their genealogies, and these, brief though they be, are the only sources for Moro history. Prior to the American acquisition of the islands the *tarsila* or genealogies were rigidly kept out of sight of all foreigners and non-Mohammedans, but the Ethnological Survey has been successful in getting copies of many of them; these have now been translated, and are published in the volume before us. The Moros comprise various tribes, which differ as considerably as the Ilocano and the Igorot; the language is Malayan, but the characters employed are Arabic, which makes the work of transliteration no easy one. Some pages of the codes are published here in facsimile; the genealogies are reproduced in the ordinary form, and an exact translation of the genealogy and commentary is also given. There are introductory sections, but perhaps it would have been well to add explanatory notes to the translations in addition.

In vol. xxxix. of the Proceedings of the Royal Society of New South Wales, and also in the Journal of the Geographical Society of Queensland for 1905, Mr. R. H. Mathews maintains (1) that Australian tribes do not practise exogamy; (2) that the eight clan tribes trace descent through the mother; and (3) that there is a cross-division, cutting through phratries and classes, in the eastern tribes. His first and second points are based on the alleged possibility of marriage with any woman of the same generation. His third point, confirmed by Dr. Howitt ("Native Tribes," p. 106 n.) in some measure, may be correct, but seems to point rather to totemic exogamy within the phratry. Mr. Mathews would do well to give (1) the names of all correspondents, and (2) actual genealogies, so that his statements can be verified. He should also explain the object of phratries and classes, if they are not regulative by marriage; success in this would greatly strengthen his case. His researches, if correct, are subversive of much that has been written of late years, but he cannot expect the anthropological world to accept his unsupported statements. If anthropology were officially recognised by the British Empire, evidence on the point would soon be forthcoming. As it is, only untrained observers are available, and much reliance cannot be placed on them.

POLONIUM AND RADIO-TELLURIUM.

Since the discovery of polonium—the first radio-active substance investigated by Madame Curie—much doubt has existed as to its true nature and as to its relationship with radio-tellurium, subsequently separated by Prof. Marckwald from radio-active bismuth salts. Several papers which have recently been published throw considerable light on the problem, without, however, giving to it a definite solution. Madame Curie (*Physikalische Zeitschrift*, No. 5) has determined the constant of decay characterising her "polonium," and finds that it is practically identical with that ascribed by Prof. Marckwald to his radio-tellurium; in both cases the activity falls to half its value in about 140 days, so that there can be little doubt that the two substances are identical. In discussing the chemical properties of "polonium," Madame Curie concludes that there is no ground for considering that it more closely resembles tellurium than bismuth. In No. 4 of the *Berichte* of the German Chemical Society, Prof. F. Giesel has investigated the radio-activity of a "β-polonium" which differs from the older polonium or radio-tellurium by its emitting β rays instead of α rays; the activity of this substance falls to half its value in 6·14 days. This value does not correspond with the rate of decay of any of the known degradation products of radium. Meyer and von Schweidler, on the other hand (Proceedings of the Vienna Academy of Sciences, February 1), have obtained a radio-active bismuth which appears to behave as a mixture of radium D, radium E, and radium F; but Madame Curie (*Physikalische Zeitschrift*, No. 6), in discussing this result, considers that polonium cannot be identical with radium D or radium E, but only with radium F. Closely connected with these researches must be mentioned an investigation by Prof. H. Becquerel (*Physikalische Zeitschrift*, No. 6) of some of the characters of the α rays emitted by radium, and by substances rendered active by radium.

MEDITERRANEAN FEVER.[1]

THE reports of the commission for the investigation of Mediterranean fever, part iv., recently issued, contains a number of important papers. It is shown that in 80 per cent. of patients the *Micrococcus melitensis* is present in the peripheral blood, but usually not in large numbers (Staff-Surgeon Gilmour, R.N.), that it can be recovered from most of the organs and tissues *post mortem*, and from the urine, but not from the saliva (Captain Kennedy, R.A.M.C.). A critical examination of the blood for the agglutination reaction, by Fleet-Surgeon Bassett-Smith, R.N., shows that the blood in 148 cases, other than Mediterranean fever, gave an agglutination reaction only in four. The four latter had recently returned from Malta, and, though suffering from other affections at the time, had had the fever. The agglutination test is therefore perfectly trustworthy. Three papers deal with the possible propagation of the disease by insects. Mosquitoes, *Culex pipiens* and *Stegomyia fasciata*, were proved to be capable of carrying infection; in one case it was highly probable that a human being had been infected in this way, and experimentally one monkey was thus infected (Major Horrocks and Captain Kennedy). In view of the observations recorded in a previous report of the natural infection of goats with the *M. melitensis*, the further investigations in this direction are of great interest. Major Horrocks and Captain Kennedy find that 41 per cent. of the goats in Malta are infected, and that 10 per cent. supplying milk excrete the *M. melitensis* in their milk, and monkeys and goats can be infected by feeding with the infected milk. Cows, bullocks, mules, and in one instance a dog, are other animals proved occasionally to be infected. Like goats, cows may transmit the micrococcus in their milk (Staff-Surgeon Shaw, R.N., and Captain Kennedy). These results suggest that a very important source of human infection is from domestic animals, particularly *viâ* milk. Ambulatory cases in man and the excretion of the micrococcus in the urine are also sources by which infection may be transmitted both to man and animals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the University of Messina, Profs. G. Bagnera and E. Bortolotti have been appointed to chairs for higher analysis and calculus respectively.

At the annual graduation ceremonial of the University of St. Andrews, on Tuesday, the honorary degree of LL.D. was conferred upon Dr. A. C. L. G. Günther, F.R.S., Prof. J. Cook Wilson, professor of logic in the University of Oxford, and Prof. A. H. Young, professor of anatomy in Victoria University, Manchester.

At Lehigh University a course in electrometallurgy has been established. In its main outline it is similar to the course in metallurgy, but differs from it in omitting assaying and geology. The time thus gained is devoted to electrical engineering. There are thus two courses of four years each offered in the department of metallurgy.

Some interesting data relating to the heating of university buildings are contained in a paper by Mr. H. W. Spangler in the Journal of the Franklin Institute of Philadelphia (vol. clxi., No. 3), in which he describes the system of heating and lighting the dormitories of the University of Pennsylvania from a central station about 1200 feet away.

In addition to the Clift-Courtauld and Pfeiffer scholarships to be awarded in June, the council of Bedford College for Women offers a Deccan scholarship in science, value 60*l.*, for three years, on the result of the entrance scholarships examination. The scholarship will be awarded only to candidates who wish to qualify themselves to earn a living, and cannot obtain their university education without pecuniary help.

A private view of the exhibition of students' work will be held at the Borough Polytechnic Institute on April 7. In view of the attention which is being directed to the work done on the Continent and in America in the direction of industrial training for apprentices, many men of science interested in educational problems may be glad to learn more of the work of an institute which has made industrial training, combined with a good educational foundation, one of its strongest features.

A preliminary meeting in connection with the second International Congress on School Hygiene, to be held in London in August, 1907, was held at the University of London on March 30. Sir Lauder Brunton, F.R.S., president of the congress, announced that French educationists and medical men have determined to do all in their power to make the congress in London a complete success, and other countries have taken the matter up. A gratifying reception has been accorded to the idea of an international congress both in Canada and in South Africa, and it is hoped that at the congress there will be a thoroughly representative gathering, not only of the colonies, but of every civilised country in the world. The congress, Sir Lauder Brunton said, promises to be one of the largest and most important ever held in London. Resolutions were adopted approving the idea of holding the second congress in London, asking the King to extend his Royal patronage to the congress, approving the steps already taken to initiate the arrangements for the congress, and inviting the cooperation of educational and municipal authorities, societies, and other representative bodies interested in education and the health and development of children during school life.

The annual dinner of the Bristol University College Colston Society was held on March 30. The president, Mr. J. W. Arrowsmith, announced the receipt of a cheque for 500*l.* from Lord Strathcona, who was unable to attend. He added that for the past six years an anonymous donor has sent the college 1000*l.* annually for its sustentation fund. The Hon. Mrs. Whittuck, of Bath, has offered 1500*l.* to form part of the endowment of a chair of economic science, provided the council of the college sees its way to establish such a chair. It has been determined to take up in earnest the task of establishing a university for Bristol, and a committee has been formed, covering the counties of Wiltshire, Somerset, and Gloucestershire. Lord Winterstoke has offered 10,000*l.*, Mr. J. S. Fry 10,000*l.*, and Sir Frederick Wills and Mr. F. J. Fry 5000*l.* each, thus making up 30,000*l.* Altogether from 150,000*l.* to 200,000*l.* are wanted. Mr. Whitelaw Reid, the United States Ambassador, and Mr. Birrell, President of the Board of Education, both responded to the toast of "Our Guests." Mr. Reid described American experience in the founding of universities. The people of the United States began by copying Oxford and Cambridge, the only two English universities in 1833; but in time they found that the demands of a new people, and of a continent that had to be subdued to the uses of civilisation, called more and more for some higher education of a different kind. Thus while the great English schools still adhered chiefly to the humanities, theirs began a divergence, which every year found more decided, towards science and its applications. The most notable tendency as yet in recent higher educational development in America is towards scientific and technological study with a specialisation always growing more precise, if not also more narrow, in reference to the student's intended pursuits in life. After describing the development of schools and institutions of higher education since the Civil War, Mr. Reid went on to say that none of these schools has money enough, though many of them have considerable amounts. First, of course, stands the Leland Stanford with its princely endowment, from one man and his wife, of between seven and eight million pounds. Next comes Columbia with more than six million pounds, then Harvard with about five and a half millions, Chicago with nearly four millions, and Cornell with nearly three. The great work of Yale has been done with true Connecticut

[1] "Reports of the Commission appointed by the Admiralty, the War Office, and the Civil Government of Malta for the Investigation of Mediterranean Fever, under the Supervision of an Advisory Committee of the Royal Society." Part iv. Pp. 187. (London: Harrison and Sons, 1906.) Price 3*s.* 6*d.*

thrift, since they cannot yet count up quite two millions of pounds; and that of Johns Hopkins, briefer but also great, has been achieved with an endowment of little above one million. The Carnegie Institute at Washington has two millions. Many of the other institutions of higher learning are far less adequately provided for; but in general it may be said that the Republic is more liberal with its schools than with anything else. In no other field do its private citizens display more generosity, and as for public expenditure, to give but one illustration, it may be mentioned that the single State of New York spent in 1905 from the public treasuries, State and local, for its schools in the neighbourhood of nine million pounds.

SOCIETIES AND ACADEMIES.

London.

Royal Society, December 7, 1905.—"On the Influence of Bias and of Personal Equation in Statistics of Ill-defined Qualities: an Experimental Study." By G. Udny **Yule.** Communicated by Prof. O. Henrici, F.R.S.

To attempt to answer the question raised by the results of the preceding investigation an experiment was conducted, by asking observers to classify under such headings as "light," "medium," "dark," scraps of photographic paper printed to different depths of colour. The results show that (1) personal equation in the use of such terms is very large indeed; (2) the majority of observers tend to return an excess of pairs of tints of the same name; (3) the amount of this excess is increased when different observers' results are pooled, owing to their varying personal equations; (4) but it is markedly less than the excess of the number of homonymous pairs (as compared with a normal distribution) in several of the tables for inheritance of qualities. The answer to the question remains therefore somewhat indefinite, and further investigation is required.

Chemical Society, March 15.—Prof. R. Meldola, F.R.S., president, in the chair.—The interaction of well-dried mixtures of hydrocarbons and oxygen: W. A. **Bone** and G. W. **Andrew.** The results of experiments carried out chiefly with well-dried mixtures of ethylene and oxygen indicate that steam is not essential to the combustion of hydrocarbons.—The explosive combustion of hydrocarbons: W. A. **Bone** and J. **Drugman.** The results of this research indicate that there is no essential difference between the slow and rapid combustion of a hydrocarbon, and that explosive combustion probably involves the initial formation of unstable hydroxylated molecules, which subsequently undergo thermal decomposition into simpler products.—The occurrence of methane among the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method: P. **Haas.** The author confirms and extends to a large number of substances Dunstan and Carr's observation that in the Dumas method of determining nitrogen in organic substances an error may be caused by the inclusion of marsh gas in the gas collected and measured.—Studies on comparative cryoscopy, part iv., the hydrocarbons and their halogen derivatives in phenol solution: P. W. **Robertson.**—The displacement of acid ions, part i.: A. F. **Joseph.** The author describes his investigations on the quantitative action of hydrochloric acid on the nitrates of potassium, sodium, and strontium, and of nitric acid on the corresponding chlorides.—Additive compounds of arylamines with aromatic nitro-derivatives: C. L. **Jackson** and L. **Clarke.** 4:6-Dibromo-1:3-dinitrobenzene dimethylaniline, 4-chloro-1:3:5-tribromo-2:6-dinitrobenzene dimethylaniline and other similar additive products are described.—Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines: J. J. **Sudborough** and N. **Picton.** The formation of additive compounds between α- or β-naphthylamine and *s*-trinitrobenzene derivatives is completely inhibited by the introduction of three methyl-, two methoxy-, or three bromo-radicals into the trinitrobenzene molecule.—The relations between absorption spectra and chemical constitution, part iv., the re-activity of the substituted quinones: A. W. **Stewart** and E. C. C. **Baly.** An examination was made of the absorption spectra of various quinones, and conclusions are drawn as to the conditions in which these substances exist.—The constitution and properties of acyl thiocyanates: J. **Hawthorne.**—A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid: H. **Rogerson** and J. F. **Thorpe.**—Aromatic sulphonium bases: S. **Smiles** and R. **Le Rossignol.** Two methods of preparing aromatic sulphonium bases are described, (1) from a sulphoxide and phenetole with a dehydrating agent, (2) from a sulphinic acid and phenetole with strong sulphuric acid.—A new form of calcium chloride tube for combustion: A. E. **Hill.** This tube is described and illustrated in the current number of the Proceedings of the Chemical Society, 1906, xxii., 87.—The viscosity of liquid mixtures, part iii.: A. E. **Dunstan.**—The action of phenylpropiolyl chloride on the ketonic compounds, part ii.: S. **Ruhemann.**

Paris.

Academy of Sciences, March 26.—M. H. Poincaré in the chair.—The methods used in the search for luminous particles mixed with the gas of the chromosphere and the solar protuberances. Application during the eclipse of 1905: H. **Deslandres.** The lines due to the gases are readily observed, but the continuous spectrum due to the presence of liquid or solid particles is much more difficult to recognise. The author attacked this problem during the last eclipse, making use of coloured screens to remove the gaseous radiations. A preliminary account of the results is given.—Observations on Gennadas: E. L. **Bouvier.** The author draws the following conclusions from his work in this and a preceding paper on the same subject: the Gennadas are clearly bathypelagic, and do not descend to live at great depths; they do not rise to the surface for reproduction, and are derived from Benthesicymus by adaptation to a bathypelagic existence.—Quasi-waves of shock in the midst of a fluid which is a good conductor of heat: P. **Duhem.**—The Oligocene basin of Ebro and the Tertiary history of Spain: Ch. **Depéret** and L. **Vidal.**—The total eclipse of the sun of August 30, 1905; solar protuberances of two colours: J. **Esquirol.**—A magic square: G. **Tarry.**—The theory of characteristics: E. **Goursat.**—Discontinuous ensembles: L. **Zoretti.**—The development of non-integrable functions in trigonometrical series: P. **Fatou.**—Hyperelliptic surfaces defined by intermediate singular functions: Louis **Remy.**—The deformation of the metals of a railway: G. **Cuénot.**—A mode of construction of aëroplanes allowing of an increase, in notable proportions, of their sustaining power: E. **Seux.**—The evaluation of the power of microscopic objectives: L. **Malassez.**—The variations of the absorption bands of a crystal in a magnetic field: Jean **Becquerel.** The spectrum of xenotime, a uniaxial crystal giving fine absorption bands, was obtained with a Rowland grating, and the effect of placing the crystal in a magnetic field examined. The resulting displacement of some of the bands was much greater than would be expected from the magnitude of the ordinary Zeeman effect in metallic vapours.—Gaseous osmosis through a colloidal membrane: Jules **Amar.** A perfectly dry colloidal membrane is impermeable to carbon dioxide; the gas diffuses through only when the membrane is moist, and the amount diffused diminishes progressively as the membrane dries.—A contribution to the study of the intermittent discharge: G. **Millochau.** New researches on bulbs producing X-rays: M. **Nogier.**—The use of the Cooper-Hewitt lamp as a source of monochromatic light: Ch. **Fabry** and H. **Buisson.** This mercury arc lamp, which is now made commercially, gives a light of uniform intrinsic lustre. The yellow and green rays are so fine as to give interference phenomena with a difference of path of 22 cm., that is to say, of an order of about 400,000. The yellow rays give particularly fine results.—The isolation and some atomic characters of dysprosium: G. **Urbain.** The author has isolated 50 grams of an earth the spectral characters and atomic weight of which show such constancy among the different fractions that it is impossible to imagine that it is a mixture. Details of the methods of separation used and the spectrum observed are given.—The commercial preparation of calcium hydride: Georges F. **Jaubert.** The product, as put on the

market, contains about 90 per cent. of calcium hydride, the remainder consisting chiefly of oxide and nitride. One kilogram of this, when acted on by water, gives about a cubic metre of pure hydrogen. The lifting power of this being about 1200 grams, calcium hydride has been already used in aeronautics.—The action of the xanthic leucomaines on copper: N. **Slomnesco.**—A new type of equilibrium reaction: L. J. **Simon.** The equilibrium studied was the reaction between urethane and pyruvic acid.—Practical details in the estimation of cadmium: H. **Baubigny.**—The estimation of the albumenoid material in milk: MM. **Trillat** and **Sauton.** The method is based upon the property of formaldehyde of rendering the milk albumenoids insoluble without affecting their weight. The working method is given, and also control analyses.—The catalytic action exercised by alkaline and alkaline-earth salts in the fixation of atmospheric oxygen by solutions of polyphenols: E. **Fouard.**—The formation and distribution of the terpene compounds in the bitter orange: Eug. **Charabot** and G. **Laloue.**—A parasite of the pearl oyster determining the production of fine pearls at the Gambier Islands: L. G. **Seurat.** The parasite is named *Tylocephalum margaritiferae*, and, owing to its pearl-forming properties, is of considerable economic importance.—The origin of the nerves: N. A. **Barbieri.**—Hæmatogen and the formation of hæmoglobin: L. **Hugounenq** and Albert **Morel.**—Aseptic hyperthermia due to operations: MM. **Charrin** and **Jardry.**—A contribution to the history of the Piedmont geosynclinal: Émile **Argand.**—A contribution to the physical geography of the Atlas chain of Morocco: Louis **Gentil.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 5.

ROYAL SOCIETY, at 4.30.—On Retardation of the Discharge of an Electroscope by Means of certain Radio-active and other Substances: Dr. W. S. Lazarus-Barlow.—On a Mineral, which retards the Rate of Discharge of an Electroscope: Dr. E. H. Büchner.—On a New Method of obtaining Continuous Currents from a Magnetic Detector of the Self-Restoring Type: L. H. Walter.—On the Distribution of Radium in the Earth's Crust, and on the Earth's Internal Heat: Hon. R. J. Strutt, F.R.S.—On the Physiological Action of a recently discovered African Arrow Poison: Dr. C. Bolton.

CHEMICAL SOCIETY, at 8.30.—An Improved Apparatus for measuring Magnetic Rotations and obtaining a Powerful Sodium Light: W. H. Perkin, Sen.—The Rusting of Iron: G. T. Moody.—On the Determination of Carbon in Soils: A. D. Hall, N. H. J. Miller and N. Harmer.—The Electrolysis of the Salts of ββ-Dimethylglutaric Acid: J. Walker and J. K. Wood.—Bromo- and Hydroxy-derivatives of βββ'β'-Tetramethylsuberic Acid: J. K. Wood.—Some new Orthoxylene Derivatives: G. Stallard.—A new Solvent for Gold. Preliminary Note: J. Moir.—The Molecular Condition in Solution of Ferrous Oxalate: a Correction: S. E. Sheppard and C. E. K. Mees.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain (*Conclusion of Discussion*).

LINNEAN SOCIETY, at 8.—*Exhibition*: Some Plants new to the pre-Glacial Flora of Great Britain: Clement Reid, F.R.S.—*Papers*: A Second Contribution to the Flora of Africa.—Rubiaceæ and Compositæ, Part II.: Spencer Moore.—The Anatomy of the Stem and Leaf of *Nuytsia floribunda*, R.Br.: E. J. Schwartz.—Taiwanites, a new Genus of Coniferæ from the Island of Formosa: B. Hayata.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Steam Turbines: G. D'A. Meynell.

FRIDAY, APRIL 6.

MALACOLOGICAL SOCIETY, at 8.—On a Species of the Land Molluscan Genus Dyakia from Siam: Lt.-Col. H. H. Godwin-Austen, F.R.S.—Descriptions of new Species of Land Shells from Peru and Colombia: S. I. Da Costa.—Note on Swainson's Genus Volutilithes: R. Bullen Newton.—Further Notes on the Genus Chloritis, with Description of new Species: G. K. Gude.—*Vertigo parcedentata*, Braun, in Holocene Deposits in Great Britain: A. S. Kennard and B. B. Woodward.

ROYAL INSTITUTION, at 9.—The Physical Basis of Life: W. B. Hardy, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Pressure-chipping of Flint, and the Question of Eolithic Man: S. H. Warren.

SATURDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Salt-making in Essex, Ancient and Modern: Miller Christy.—Neolithic Man in Epping Forest: F. W. and H. Campion.

MONDAY, APRIL 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Presentation by H.E. the American Ambassador of the Gold Medal of the American Geographical Society to Captain R. F. Scott, Commander of the National Antarctic Expedition.—*Paper*: Recent Exploration and Survey in Seistan: Col. Sir Henry McMahon, K.C.S.I.

VICTORIA INSTITUTE, at 4.30.—The Bible in the Light of Modern Science: W. Woods Smyth.

TUESDAY, APRIL 10.

ZOOLOGICAL SOCIETY, at 8.30.—The Freshwater Fishes of the Island of Trinidad, based on the Collection, and Notes and Sketches, made by Mr. Lechmere Guppy, Jun.: C. Tate Regan.—The Marine Fauna of Zanzibar and British East Africa from Collections made by Cyril Crossland in the Years 1901–2. Alcyonaria: Prof. J. Arthur Thomson and W. D. Henderson.—(1) Cyclopia in Osseous Fishes; (2) Notes on Supernumerary Eyes, Local Deficiency and Reduplication of the Notochord in Trout Embryos: Dr. J. F. Gemmill.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Resistance of Iron and Steel to Reversals of Direct Stress: Dr. T. E. Stanton and L. Bairstow.

FARADAY SOCIETY, at 8.—Note on the Rotating Electric Steel Furnace in the Artillery Construction Works, Turin: E. Stassano.—Electrothermics of Iron and Steel: C. A. Keller.—Recent Developments in the Gin Electric Steel Furnace: G. Gin.—Note on the Cleaning of Work by Means of the Electric Current: H. S. Coleman.

WEDNESDAY, APRIL 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.

PAGE

THURSDAY, APRIL 12, 1906.

THE PHYSIOLOGICAL EFFECT OF LIFE IN THE ALPS.

Höhenklima und Bergwanderungen in ihrer wirkung auf den Menschen. By N. Zuntz, A. Loewy, F. Müller, and W. Caspari. Pp. xvi+494, and tables. Dedicated to E. Pflüger, in celebration of the jubilee of his doctorate. (Berlin: Bong and Co., 1905.)

ALPINE literature has a special charm; it re-kindles memories of happy hours spent among the mountains, and thrills us with echoes of that intense delight in life which was the prominent characteristic of days in Switzerland. No doubt many things contribute to the pleasure which the Alps give to thousands of men and women, but one obvious and potent factor is the sense of well-being; we feel that, like the elixir of life, mountain air and scenery rejuvenate body and mind.

In the important work just published by Prof. Zuntz, Prof. Loewy, and their comrades, a scientific basis is afforded for this rejuvenating influence. The volume contains an account of an expedition undertaken expressly to carry out physiological investigations at high altitudes. Such expeditions have been frequently made, the most notable being the pioneer one of Paul Bert, the extensive one of Kronecker and his colleagues, and those which Mosso has repeatedly carried out in the Monte Rosa district. The expedition conducted by Prof. Zuntz has no doubt reaped great advantages from the study of the work of its predecessors, and the results achieved are in consequence more convincing, and from the physiological standpoint more valuable.

Since the object of the expedition was the enlargement of physiological science, the essential features of the account are of necessity somewhat technical. But the volume contains many passages which are of general interest, including an extensive historical account of earlier expeditions. There are in every one of the twenty-two chapters passages which will appeal to all those who love the Alps, for Prof. Zuntz is himself one of this fraternal band, and reveals his own enthusiasm not only by the character of the descriptive writing, but more directly by the interpolation of many beautiful Alpine illustrations. Moreover, such practical details as clothing, food, and exercise are dealt with from the alpinist's point of view, and what is termed "sport" is treated in a most suggestive way.

To the majority of readers, especially if they should be medical practitioners, the most interesting portions of this really great work will be those which set forth the peculiarities of the climate in high altitudes and the influence which these peculiarities must exert, not only on vigorous athletes who climb the topmost peaks, but on the ever-increasing number of less ambitious mortals who seek the Alps in order to restore shattered health, or to check the advance of disease. In chapter xx. the benefits and dangers of life in moderately high altitudes are set forth in the light of the results of the expedition; the new basis for estimating the value of such benefit or the extent of such danger which is given in this part of the work should of itself secure the general reputation of the volume owing to its direct bearing upon some of the most important hygienic topics of the day.

It is impossible in the short space of this notice to do justice to such a comprehensive volume, but since the essence of the work lies in the physiological effects which were observed at high altitudes, and these form the basis referred to in the preceding paragraph, a brief summary of the physiological results must be attempted. In order to realise their nature, the plan of the expedition will be first described.

Two physiological professors, two assistant professors, and two younger members of the medical profession engaged in physiological research formed the *personnel* of the expedition. For more than twelve months each member of the party had made elaborate experiments of a preliminary character in the Berlin laboratories in order to become efficient in the quantitative work necessary for the investigation of the body metabolism. The details of the expedition were planned with great care and forethought; valuable aid was afforded by Prof. Kronecker, of Berne, and Prof. Mosso, of Turin, the most essential feature of this help being the offer of the working laboratories established in the Brienz district by Kronecker and in the Monte Rosa district by Mosso. In July, 1901, the actual work was begun at Brienz. This is situated at the east end of the lake of that name, and lies at the height of 1857 feet; it is connected by a mountain railway with the summit of the Brienz Rothhorn (7713 feet). At Brienz each member of the party, by strict diet and other precautions, placed himself in a condition of nitrogenous equilibrium, that is, a condition in which the quantity of nitrogen assimilated from the food is equal to that excreted in twenty-four hours. After a few days the party divided, three members going by train to the summit of the Brienz Rothhorn, the others remaining at the lower level; both groups performed given amounts of muscular exercise and conducted similar physiological investigations. Finally the groups changed places, and the work was continued as before. This formed the first part of the inquiry; the second part was of a more severe character. Starting from that delightful valley in which Gressoney-la-Trinité nestles amongst the flowery slopes of the Lysthal, the party ascended to the Col d'Olen, where, at a height of 9420 feet, Mosso has established his lower mountain laboratory. After spending some days in preparations, four members of the party and Prof. Sella, of Rome, climbed with guides and porters to the summit of the Signal Kuppe or Point Gnifetti of Monte Rosa, 14,965 feet. Here they stayed for seven days in the hut, now widely known as the Capanna Osservatorio Regina Margherita, which was erected for experimental pur-

poses through Mosso's endeavours. The first days were most tempestuous, and the account of the stay on the summit is full of interest; an incident in the week was the recovery of a collapsed Alpine tourist, who, to the surprise of the party, turned out to be a lady. The whole party suffered more or less severely from mountain sickness, and a valuable part of the investigations deals with this familiar complaint.

Animals were taken up all the ascents for experimental purposes, others being left below for control observations.

The physiological results are related respectively to the influence of moderate altitudes, *i.e.* up to 7500 feet, and of high altitudes up to nearly 15,000 feet, the former being chiefly the Brienz-Rothhorn experiments, the latter the Monte Rosa ones. They may be briefly summarised under the following different headings :—

(1) *Blood Changes.*—It is now well known that, as first suggested by Paul Bert, the blood is altered in high altitudes. The most striking change is that discovered by Viault, who found that the red blood corpuscles increased from five millions to seven or eight millions per cubic millimetre of blood. Similar increase was observed in the present expedition, but it was somewhat uncertain in character. The determination of the specific gravity of the blood and of the serum showed that the increase when present was not due to plasma diminution through the excessive evaporation of perspiration; moreover, an examination in animals of the tissue which is the seat of the corpuscular formation (the red marrow of the bones) showed that this was in a state of greatly augmented activity. There is therefore no question that the red corpuscles increase in number, and the authors state in their work that the stimulating influence is the diminished oxygen tension of the blood itself.

(2) *Digestive Efficiency.*—By careful quantitative examinations of the food and excreta, it was shown that altitudes up to 8000 feet exercised a favourable influence upon the completeness of the digestive processes, the indigestible residues diminishing especially when the surroundings were cold. In very hot surroundings this favourable influence was not so apparent, and in these circumstances muscular exertion caused it to be of the reverse type. At very high altitudes, 14,900 feet, the efficiency of digestion was greatly impaired.

(3) *Oxidation Processes.*—The extent of these was determined by the relation between the absorbed oxygen and the total heat production of the body. It appeared that even at such low altitudes as 1500 feet the total oxidation was increased, this being exceptionally high during muscular exertion, whilst in moderate and high altitudes the oxidation processes were greatly increased. The increase is set down to two circumstances; firstly, the diminished thermogenetic capacity of the muscles, which are impaired by the inadequate supply of oxygen in their circulating blood, thus throwing the necessary heat production upon the oxidation of more complex compounds than those offered by the muscles; secondly, the presence in the tissues of abnormal oxidisable substances.

(4) *Proteid Metabolism.*—The most important of the numerous changes brought forward in the results of the expedition are those connected with the fundamental nitrogenous substances, proteids. It has been firmly established in physiology that whilst every growing animal assimilates through food more nitrogen than is excreted, this is not the case in the adult except in special circumstances. Growth implies proteid storage, which is believed to be utilised for the increased formation of cellular structures, and even in the adult such local muscular growth may occur as the result of special muscular exercise, training, &c., but it soon reaches a limit and is comparatively insignificant. In the convalescent it is a marked feature of recovery from wasting illness. After making due allowance for all disturbing influences, a most important result was arrived at by the work of the expedition. Even at Brienz (1500 feet) a stage was reached in which the total N-import exceeded the N-export, whilst on the Rothhorn this excess was most marked. Moreover, this phase of metabolism persisted for a considerable time after leaving the moderately high altitude. This implies the production of a phase of nitrogenous metabolism resembling that of the growing animal; it is, in short, a renewal of youth. It is noteworthy that along with this nitrogen storage there was no corresponding increase of body weight, the intensity of the oxidation processes in non-nitrogenous compounds being more than sufficient to mask the proteid gain. At the highest altitudes the gain was not so apparent, but this is amply accounted for by the digestive derangement which was associated with the mountain sickness.

(5) *Respiration and Circulation.*—The decrease of the oxygen tension in the blood in consequence of the decreased partial pressure of the oxygen of the air was in accordance with the results obtained by Hüfner and others in connection with hæmoglobin. In opposition to Mosso's results the authors found that there was not a decreased tension of carbonic acid in the blood. They bring forward evidence which suggests that deficiency of oxygen in the blood can, like excess of carbonic acid, stimulate the respiratory centre; this is of interest as it is opposed to the physiological view now generally accepted. The peculiar type of breathing known as the Cheyne-Stokes respiration, described by Mosso as occurring at high altitudes, was observed by the members of the expedition on Monte Rosa, but the explanation now advanced is quite different from that offered by Mosso. Zuntz regards the phenomenon as impaired activity of the respiratory centres, which are only capable of being adequately roused if the carbonic acid has by accumulation reached a certain tension in the blood.

As regards the circulatory changes, the only one of a fundamental character appeared to be due to the altered activity of the heart. At moderate altitudes the heart's activity, like that of the respiratory mechanism, is augmented to meet the need for more oxygen and more effective oxygen transport by the blood, but at very high altitudes there appeared to be

a great tendency to cardiac weakness owing to the direct action of insufficient oxygen in the blood supplying the muscular walls of the heart.

This scanty and imperfect sketch may serve to show the very extensive field which is covered by the physiological work of the expedition, but, in addition, many valuable observations were made upon the symptoms, progress, and nature of mountain sickness. The cause of this complaint is, according to the authors, the deficiency of oxygen transport by the blood. The individual variations in the manifestation of the symptoms and the disappearance of the symptoms on habituation are considered to be due to the relative adequacy or inadequacy of the mechanisms by which the organism endeavours to protect itself against this oxygen deficiency. One such mechanism is the circulation flow, and if this is unable to bear the strain of increase, then nervous influences diminish the vascular area of the digestive organs in order to supply, so far as practicable, the higher nerve centres in the brain; in consequence of this anæmia, an extensive derangement of the digestive functions is produced which shows itself in the sickness and other symptoms that are the characteristic features of the trouble.

In conclusion, attention must be directed once again to the practical bearing of the Rothhorn experiments. These deal with the effects produced by moderately high altitudes, and to such altitudes thousands of men and women go every year, whilst the numerous sanatoria frequented by invalids are situated at these elevations. Moderate altitudes of less than 8000 feet appear, in consequence of the lessened atmospheric pressure, to benefit the whole organism in the following particulars. The tissue which produces the oxygen carriers of the blood is stimulated into greater activity, the oxidation of abnormal substances is increased, the heart's action is augmented, the respiratory muscular mechanism is brought into more energetic use, and, finally, that proteid assimilation which is so directly related to cell growth and cell restoration assumes the phase present in the young and growing animal. In consequence of all these changes, and particularly the last one, altitudes of from 4000 to 7000 feet must exercise a most beneficial and even rejuvenating influence. In the case of many invalids the effect will be to arm the body for its fight against such insidious foes as the tubercle bacillus and to hasten recovery in all cases of convalescence from bodily or mental prostration. Only those whose circulation is seriously impaired directly or indirectly by organic disease are debarred from the probability of such beneficial effects.

Experience has revealed to many the profound truth which is expressed in the beautiful and familiar words, "I will lift up mine eyes unto the hills, from whence cometh my help." In their monumental work Prof. Zuntz and his colleagues present physiological reasons for the assurance that whilst mountain scenery may arouse the imagination, mountain air will stimulate those organic functions which form the foundation for health of body and happiness of mind.

F. G.

A COMPREHENSIVE DYNAMICS FOR PHYSICISTS.

The Dynamics of Particles and of Rigid, Elastic, and Fluid Bodies. By Prof. Arthur Gordon Webster. Pp. xii+588. (Leipzig: B. G. Teubner, 1904.) Price 10 marks.

Attention has been directed in more than one recent review to the tendency to over elaboration in the standard treatises to which an English reader would naturally turn for information on such branches of applied mathematics as the principle of least action, the potentials of ellipsoids, or the equations of motion of a perfect fluid. What has been said already must be said again, in order to make good the claims which Prof. Webster puts forward in his preface, and to prove that this book, written by an American and published in Germany, fills a distinct want.

That the student of physics should have to consult five volumes of Routh, three of Love, and a large work of Lamb is a state of affairs which could not very well be allowed to continue. It is true that these treatises afford an excellent preparation for the man who proposes to devote his whole lifetime to mathematical research, regardless of cost. But it is becoming more and more evident that the physicist must know something about the intricate mathematical machinery which has been so successfully employed to bring a large proportion of physical phenomena into one connected theory. We include under this category reversible phenomena. Whether the subject-matter of this book is called dynamics, or the study of quadratic forms, or the theory of geodesics in a hyperspace with special reference to particular definite applications makes no difference. The present reviewer may perhaps be allowed once more to state his conviction that irreversible energy transformations, whether statistical or non-statistical in character, cannot satisfactorily be accounted for as properties of quadratic forms except by the method of energy-accelerations, that is, by studying the *second*, and not the first, differential coefficients with respect to the time of the squares and products occurring in the energy function. But the omission of these phenomena leaves a great portion of modern physics which cannot be properly understood without some knowledge of a very extended and very advanced portion of applied mathematics.

In his preface—which, by the way, is so exhaustive as to leave a reviewer but little fresh to add—Prof. Webster states of the book that "It is obvious that it leads to no particular examinations, from which we in America are to a large extent fortunately free." Examples, as such, are therefore omitted, although most of the standard applications of general principles are included in the text; for instance, motion of a spherical pendulum, the brachistochrone and tautochrone under gravity, potentials of a disc and cylinder, form of a rotating liquid in a uniform field or under self-gravitation, torsion of elliptic and triangular prisms, and so forth. In connection with these applications an intentional feature is very con-

spicuous, namely, the attempt, wherever practical, to illustrate the conclusions by diagrams or by appeal to experiment. Prof. Webster is a firm believer in both the analytical and the geometric method, and he rightly emphasises the importance of Lagrange's monumental work, in which there are no figures, but only algebraic equations. But *in the interpretation of results* the geometrical method is often the most fruitful, and it certainly appeals best to the reader who, like Prof. Webster, regards geometry as a physical subject. Possibly it is not so generally known as it ought to be that one important branch of dynamics, namely, uniplanar rigid dynamics, can be treated practically without the use of analysis by drawing diagrams for each problem, and inserting a force, Ma, at the centre of each mass, and a couple, $Mk^2d^2\theta/dt^2$, about that centre. Be this as it may, the curves illustrating the motions of tops, the compounding of oscillations, and similar problems convey much more meaning than a mere formula.

The book consists of three parts. The first deals with general principles and applications to systems of particles. It contains the principle of least action, the theory of free and forced oscillations for finite systems, and a short account of the theory of cyclic systems. The second deals with statics and dynamics of a rigid body. The third practically treats of continuous distributions of matter the dynamical properties of which are determined by partial differential equations with regard to the space-coordinates. By this we include attractions, theory of the potential, spherical and other harmonic analysis, elasticity, hydrostatics, hydrodynamics and sound.

Like every other book, this one has some good features and some defects. To take one or two small instances chosen at random; it is pointed out, rightly (p. 205), that the statement that forces applied to a rigid body are sliding vectors with five coordinates is not a property of forces, but of rigid bodies. On the other hand, it would be surely better to employ the word translation for rotation-couple on p. 209. Again, on p. 404, the expression for the potential of a distant body is not nearly so convenient as the ordinary form involving $A+B+C-3I$, which is not given.

Prof. Webster assumes a fair knowledge of the calculus, but not of differential equations or of higher analysis. It would, however, appear that a fair knowledge of the geometry of x, y, and z is needed; in evidence of this need, the equation

$$\cos^2\lambda+\cos^2\mu+\cos^2\nu=1$$

appears assumed on the second page. For anyone so equipped, Prof. Webster has "attempted to provide a treatise which would in not over a year's time offer to the student an amount of knowledge of Dynamics sufficient to prepare him for the study of Mathematical Physics in general."

But we are surely justified in examining what chances the English student of physics or engineering has of taking his place beside his American and German rivals in drawing upon this store of knowledge. The hopes that might have been raised a year or two ago as to prospective reforms in mathematical teaching will be sadly dispelled by a study of recent papers set in examinations for leaving school or matriculation. In these we find the old tendency to choke off the learner of an inquiring turn of mind, the old artificial questions on solving meaningless equations and simplifying meaningless expressions, mostly fractional, in short, everything best calculated to encourage mere mental gymnastics and to destroy all power of intelligently assimilating new ideas. The training required to produce a human examination-answering machine capable of working at matriculation level and of going no further would, if directed into a right channel, enable that same learner to differentiate and integrate rational algebraic functions, to calculate the areas of their graphs, and perhaps in the third year of a college course to read this book. G. H. B.

A NATURALIST'S PHILOSOPHY.

Essays on Evolution and Design. By the late Prof. John Young. Edited, with an analysis and an introduction, by William Boyd. Pp. xiii+248. (Glasgow: James Maclehose and Sons; London: Macmillan and Co., Ltd., 1905.) Price 6s.

MANY who knew the late Prof. John Young as a versatile thinker and keen critic will be interested in this posthumous volume which discloses his philosophy. To a wider audience the book will appeal by its vigorous criticism of mechanistic interpretations, its protest against theories of fortuity, and its confession of faith in a cosmic plan. The author seems to have felt acutely that the scientific formulations which attempt to give a genetic description of how things have come about fall very far short of being adequate, and that in any case they are never *explanations* which will satisfy the human spirit. Prof. Young sought to show that whether we consider the fundamental concepts of matter and force, the living organism, or the mind of man, we find that the naturalistic scheme is either guilty of *petitio principii* or of that "materialism" which attempts to give a false simplicity to the facts. The principle of continuity breaks down at every point, and our only alternative to giving up scientific explanation (as so many have done) is to fall back on the idea of design, and to make appeal to "the regulating influence of plan of some sort."

To many it will appear that the bulk of the book is an *argumentum ad ignorantiam*, and that many of the failures in scientific interpretation on which the author laid an incisive finger are only partial and temporary failures. Where he found insuperable difficulties, *e.g.* in the application of the selectionist theory, others find corroboration and encouragement. But it may serve a useful purpose to have vividly pointed out some of the difficulties involved in the origin of living organisms with individualities of their own, in the evolution of many important phenomena of animal structure and function, in the rise and progress of mental life, and in the emergence of the distinctively human "ought." If we under-

stand the author aright, he believed not merely in a "cosmic plan," not merely in a "will behind phenomena," but that "processes are directed by an external power."

Prof. Young seems to have taken the evolution theory *cum grano salis*; he thought that the origin of variations is left unaccounted for, that natural selection is an over-rated factor, that it is a modal, not a causal principle, "subordinated to something other than itself," that the Lamarckian interpretation cannot be disregarded, and that far too little attention is paid by naturalists to the individuality of the organism itself. But apart from his insistence on the necessity of recognising "the regulating influence of plan of some sort," his book is critical rather than constructive. It is matter for regret that he did not live to work out the positive part of his thesis, that "many facts in various fields of inquiry point to the existence of a plan."

The value of the book is increased by an able introduction by the editor, Mr. William Boyd, who also supplies an admirable synopsis of each chapter. It is evident that the essays were not intended by Prof. Young to be given to the public in their present form, for in some parts the argument is neither accurate nor clear. Thus, in regard to Weismann's conception of the germ-plasm, the author wrote:—

"Romanes makes the difficulty more obvious by showing that Weismann's view requires us to believe that the germ plasm is independent of and unaffected by what happens to the parent. It is impossible, therefore, for acquired characters to exist, far less to be transmitted; for no variation, however favourable, can take place unless it was foreshadowed in the ancestral protoplasm. This protoplasm was the component of the first simple forms which came into being. It is immortal. On its characters depend those of its most remote descendants. Now on this view these characters must be represented by particles of some sort, certainly of some magnitude. *What is this but to declare design in its most authoritative form?*"

Still more perplexing is the comparison of the sea-urchin's pedicellariæ with young Crinoids, and the aviculariæ of Polyzoa with Brachiopods.

OUR BOOK SHELF.

Heat and Steam (Elementary). An Introductory Supplement to a Text-book of Marine Engineering for the Use of Naval Officers, &c. By Engineer-Commander Tompkins, R.N. Pp. 54. (Portsmouth: J. Griffin and Co.; London: Simpkin, Marshall and Co., Ltd., 1906.) Price 1s. 6d. net.

The author is instructor in steam and marine engineering at the Royal Naval College, Greenwich, and has prepared a text-book on marine engineering, primarily for the use of naval officers. This text-book has reached a second edition. In connection with recent changes in the training of cadets and junior naval officers, a new syllabus of instruction in heat and steam has been issued by the Admiralty. As a consequence, Commander Tompkins has found it necessary to modify certain portions of his text-book, and has done so in the present pamphlet, which he terms an "Introductory Supplement." Young naval officers will be enabled to use this at once, in association with the text-book, and as soon as arrangements can be made the new matter is to be incorporated in the second edition.

The supplement follows the text-book in clearness and simplicity of treatment, and should be of great value to the classes for whom it has been chiefly prepared. It embraces a brief historical review of the development of steam engines; an excellent summary of the principles of thermodynamics, written in simple language; and a sketch of the applications of those principles to engine design. The work is well up to date; it contains explanations of the types of steam turbines introduced by Parsons and De Laval, and of approved types of water-tube boilers. Measurement of power, the mechanical equivalent of heat the sources and conservation of energy, and estimates of efficiency are dealt with in a manner that makes the subjects intelligible to readers possessing only moderate mathematical knowledge. Some of the illustrations are based on most recent practice, including results obtained by the cruiser *Amethyst* fitted with turbine engines, and the sister ship *Topaze* fitted with reciprocating engines. Commander Tompkins has taken great pains to meet the requirements of the readers for whom the work has been primarily undertaken, and he has succeeded. Outside the officers of the Navy, however, there are many persons who may benefit by his work, especially those who desire to understand the principles of the steam engine and whose mathematical knowledge is limited.

Atlas of Japanese Vegetation. Edited by Dr. M. Miyoshi. Sets i.–iii.; plates 1–24. (Tokyo: Z. P. Maruya and Co., Ltd., 1905.)

These are the first three parts of an atlas depicting various types of Japanese vegetation, and containing twenty-four plates, accompanied by an explanatory text in English and in Japanese. The plates are reproductions from photographs, and it is remarkable, considering the skill and cheapness of artistic labour in Japan, to find that the plates of the third part bear the legend "printed in Germany."

The plates are of varied interest. Those in the first part will prove attractive to owners of gardens in this country. Plate vi. is a view of a garden laid out in Japanese style, and shows a scene entirely different from the so-called Japanese garden which is often seen at great houses in England, and where there is nothing characteristically Japanese in the arrangement of the plants or in the general effect produced by the laying out of the ground. A view of an iris garden is very pretty. Mr. Miyoshi states that the Japanese have evolved nearly 400 varieties of *Iris laevigata* var. *Kaempferi*, which show marvellous diversity in the size, shape, and colour of the flowers, and even in the character of the leaves. *Prunus mume*, also figured, is a Chinese species, so long cultivated in Japan that it is now generally known as the Japanese plum, and of it there are now more than 300 distinct varieties.

The second part consists mainly of forest scenes, the most peculiar of which is one of the Japanese beech (*Fagus Sieboldi*), with a dense undergrowth of *Sasa nipponica*, a small broad-leaved bamboo. The Japanese larch, the Hondo spruce, and some other trees are also figured. The third part is of great interest, showing pictures of plants in the little-known Loochoo Islands, and of these the most curious is a scene representing *Cycas revoluta* dotted over an extensive landscape. There is also a good picture of the screw-pine, *Pandanus odoratissimus*, the leaves of which are now being made into hats by the Japanese in Formosa.

Augustine Henry.

The Integration of Functions of a Single Variable. Cambridge Tracts in Mathematics and Mathematical Physics, No. 2. By G. H. Hardy, M.A. Pp. viii+53. (Cambridge: University Press, 1905.) Price 2s. 6d. net.

Now that function-theory is fairly well developed, it is much easier than it used to be to discuss in an orderly way the elementary problems of explicit integration. By showing how this can be done, Mr. Hardy has produced a very instructive and pleasant supplement to the ordinary text-books. Moreover, he has done a useful service by emphasising the work of Liouville, whose theorem (quoted on p. 49) is of great generality, and occurs with others in memoirs which have not, perhaps, received all the attention they deserve. To these memoirs, as well as those of Abel, Tchebichef, &c., reference is made in the notes and appendix; this, of course, adds greatly to the value of the pamphlet.

It must be remembered that the "Cambridge Tracts," of which this is No. 2, are not intended to be exhaustive, but rather suggestive and helpful to those who are really interested in the progress of mathematical theory, and prepared to study it at first hand. Mr. Hardy seems to have carried out this idea as well as his opportunity admitted; and his reader ought to feel that he gets his half-crown's worth of entertainment. For example, on pp. 13–16 we have Hermite's beautiful way of finding, by elementary *rational* operations, the rational part of the integral of a rational function, and in connection with this an example involving, in an unexpected fashion, the theory of invariants. To the remark on p. 38 it may be added that the problem of deciding whether a given integral is pseudo-elliptic or not is likely to be of a nature quite similar to that of deciding whether two given conics can be associated with poristic circum-inscribed polygons. No finite number of rational operations can give an answer; but we can decide whether poristic polygons of any *assigned* number of sides exist or not. To the references on this subject the names of Halphen and Kowalevsky might have been added.

The Laboratory Book of Dairy Analysis. By H. Droop Richmond, F.I.C. Pp. viii+90. (London: C. Griffin and Co., Ltd., 1905.) Price 2s. 6d. net.

With the progress of technical instruction in dairying a need has arisen for a little handbook on milk composition and simple methods of milk analysis for dairy managers. There is also a need for a short handbook of dairy analysis for the trained chemists who find themselves called upon to undertake analyses of milk, cream, butter, and cheese in the laboratories of agricultural colleges and institutions. Mr. Richmond has attempted to serve both purposes in one little volume, and, as might be expected, the result is not entirely successful. For the chemist the illustrations of laboratory assistants performing simple laboratory operations, such as using a wash-bottle, are, to say the least, unnecessary, while to the dairy manager who is not a chemist the directions for the more difficult analyses would be quite unintelligible.

However, for the chemist the book provides a mass of useful details in a concise form. The analytical methods are well chosen, though it is curious to find no mention of the Westphal balance for the determination of the specific gravity of milk; and we can detect no errors or inaccuracies, though there is occasional need for greater clearness, for example, in the meaning of "the Reichert-Wollny figure." These defects are unimportant, and the book will find a useful place in many an agricultural laboratory.

T. S. D.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Chemistry in Rural Schools.

It has no doubt caused as much surprise to others as it has to myself to read, on the authority of the principal of the South-Eastern Agricultural College, that "chemistry is one of the least suitable of the natural sciences to teach children whose lives will be, or ought to be, spent in the country" (M. J. R. Dunstan, NATURE, March 29, p. 511). I have no doubt that Mr. Dunstan has good reasons to assign for this expression of opinion, but those who are interested in the subject of education in rural schools will probably want some more explicit statement before reconsidering their curricula. For my own part I had come to an opposite conclusion. It has been my privilege during the last few years to have been associated with the founders of two rural schools, one in Essex and the other in Sutherland. The curricula of these schools were very carefully considered by my colleagues and myself, and the question of the suitability of chemistry was never raised; on the contrary, we considered that from the disciplinary as well as from the utilitarian point of view it had everything in its favour. Nor have we had any reason during the existence of these schools to doubt the wisdom of including chemistry in the curricula. As a means of training in experimental method and of inculcating habits of careful observation and accurate reasoning, this science (with physics) has been taught with the greatest success. It is popular with the pupils and of distinct value to them in after life, even when that life is "spent in the country."

Perhaps the best justification I can offer for the conclusion to which my own experience has led me is furnished by the Sutherland Technical School, founded three years ago at Golspie by the Duchess of Sutherland. The pupils in this school are as "rural" a set of lads as could be gathered from any part of the Highlands, being for the most part of the crofter and fishing class. Their age varies from twelve and a half years upwards, and the course of instruction extends over a period of three years. During the first year four hours a week are given to elementary practical physics, and the same amount of time to practical chemistry during the second year. Both physics and chemistry will be continued in the third year. The headmaster, Mr. E. W. Read, writes to me as follows:—"The boys like the work, and find no particular difficulty with it: besides, I find their knowledge a great help in the natural history lessons and in the gardening. Further, I feel strongly that the mental discipline of chemistry properly taught is very great, and is likely to put a boy's mind in the attitude of desiring to keep pace with the progress of the times. Most of our boys will have to go straight to work, and I should be very sorry if a single one left without some knowledge of elementary chemistry."

We have had a similar experience in Essex, and it would be of interest to learn from others who have first-hand knowledge of the teaching of science in rural schools of a similar type to those founded by the Countess of Warwick and the Duchess of Sutherland how far chemistry has been successful as a recognised part of the curriculum. It would appear from Mr. Dunstan's letter that he considers this science to have been inserted in the curricula at the expense of the biological sciences. This is not the case in the two schools with which I am concerned. Natural history subjects (in the broad sense) are also taught, and one of the reasons which weighed with us in including chemistry was that an elementary training in this subject was considered essential as a preliminary foundation for the biological subjects. With respect to the education of young men who are actually "on the land" or who are preparing for rural occupations, the teaching of chemistry at the Central School of the Essex County Council at Chelmsford has always been most successful, both in popularity and in subsequent results. The former staff instructor, Mr. T. S. Dymond, now of the Board of Education, to whose zeal and ability the successful intro-

duction of chemistry among the Essex farmers and horticulturists is largely due, could no doubt furnish some interesting information on this subject. At any rate, it was by the close observation of Mr. Dymond's work during the period of my connection with the Essex Technical Instruction Committee that I was most strongly convinced of the suitability of chemistry as a subject for secondary rural schools.

Mr. Dunstan may, however, not include the work being done at the Chelmsford central school within the range of his criticism, as the pupils there catered for are certainly beyond the age of those attending the other two schools dealt with in this letter. In defending the claims of chemistry as a suitable subject—not dogmatically, for I am quite open to arguments against my view—it is hardly necessary to say that the most liberal interpretation of the definition of the term is asked for, and that my advocacy presupposes that the subject is properly, *i.e.* scientifically, taught. I am quite aware that distinguished authorities like Prof. Clifford Allbutt and Sir William Ramsay have expressed views similar to those of Mr. Dunstan. That makes it all the more necessary, however, to raise the whole question and have it authoritatively handled in the interests of rural education. R. MELDOLA.

April 5.

Carnivorous Habits of the New Zealand Kea Parrot.

IN your issue of December 28, 1905, there occurs a note referring to statements made at a meeting of the Philosophical Institute of Wellington with regard to the habits of *Nestor notabilis*, to the effect that the carnivorous habits that have been attributed to this parrot are exaggerated, if not totally untrue. It is unfortunate that this report of the meeting has obtained the wide currency that NATURE will give it, for it is abundantly evident that the speakers at Wellington were unacquainted with the facts about the kea.

In the course of various trips about the South Island of New Zealand during the last five or six years, I have made inquiries from shepherds and others likely to know about the kea as to how far their own personal acquaintance with this bird tallied with the common statements that they attack sheep. I was surprised to find that, in North Canterbury and in Marlborough, these men doubted the truth of these statements. They had never known the kea attack sheep in these districts. I was, consequently, inclined to take the view just put forward by the members of the Wellington Institute. I then wrote a series of identical letters to run-holders, shepherds, and others who were supposed to have had experience in this matter in Otago, with the result that overwhelming evidence of the existence of this habit was presented to me. Possibly the "naturalists and estate agents" of the Wellington Institute had not tapped the right district; that they gave their opinion in good faith I do not for a moment doubt.

It must be borne in mind that the kea is confined to the high mountainous country of the South (or Middle) Island, and does not occur in the North Island. It lives in the rough mountain tops in Alpine districts, and it is in this high, rough country that the damage to sheep has occurred, as Sir W. Buller has pretty fully described in his monograph on the "Birds of New Zealand."

It was in the Wanaka district, in Otago, that the greatest amount of damage was done in the early days of sheep-farming, and it was to managers of stations, to shepherds, musterers, and "kea shooters" employed on some of these stations that my inquiries were directed.

Several of these run-holders lost sheep by thousands, and reckoned their losses from kea attacks by thousands of pounds; some were practically ruined by the kea and the rabbit combined.

They engaged men specially to shoot and otherwise destroy keas; the county councils gave 1*s.* to 2*s.* 6*d.* a head for the birds; the squatters and Government also paid for beaks. Is it probable that these people would expend hundreds, nay, thousands, of pounds on a chimera?

Let me quote one or two extracts from letters received by me from men who have seen the kea attacking sheep, who have seen the sheep coming in at muster with holes in their sides and the entrails hanging therefrom, and on shearing have noted the wounds on the skin. These men, I may say, are well known in the district, and I have taken every care to apply only to those whose word may be relied on to give their own personal experience. These letters I hope to publish in full in the Transactions of the New Zealand Institute next year, so that their personal experiences in the early days of sheep-farming may be preserved.

Mr. Fraser, now stock inspector in Nelson province, writes:—"I was engaged sheep-farming in the Hawea and Wanaka lake districts in 1871–1883. I lost thousands of sheep from keas. I have seen the kea attacking the sheep, and also eating into a sheep when the latter was stuck in deep snow. I have opened scores of kea crops and found wool and meat therein. I have laid poison in dead sheep in snow, gone back later and found dead keas."

It was at Mr. Henry Campbell's station near Lake Wanaka, Otago, that these injuries to sheep were first (in 1868) traced to the kea, and I quote a letter from a Mr. J. H. King, who, early in the 'seventies, was employed to shoot the keas:—

"I have seen a flock of twenty or thirty birds attack a mob of sheep in the high precipitous country. The sheep as soon as attacked would huddle together as if driven by dogs; the keas would harass them until one kea would suddenly alight on a sheep's back, holding on to the wool of the rump. The sheep so attacked would immediately single itself from the mob and rush frantically about, and would either go over a bluff or drop down from exhaustion, when the kea which had still held on was joined by several others, and they soon destroyed the sheep."

Mr. King has shot a kea which was on a sheep's back.

It may be noted that the attacks are mostly made at night, hence the rarity of personal observation of these attacks; that they occur in a comparatively limited area, from the region of Mount Cook and the Mackenzie country in South Canterbury to the Takitimu range in Southland, but the centre of the area is round lakes Wanaka, Hawea, and Wakatipu.

Finally, as a comment on the irresponsible statements made at the Wellington Institute, I may quote from the *Otago Daily Times* of February 16, 1906:—"A meeting of landholders at Culverden to-day passed a resolution urging the Government to increase the bonus of 6*d.* each paid for keas' heads, and asking the county councils of Canterbury affected by the kea nuisance to cooperate with them in petitioning the Government for assistance in reducing the pest. The keas have been very numerous in the mountainous parts of Amuri county during the last two years. They seem to have moved northwards from Otago. . . ."

The report then proceeds to give the experiences of various Canterbury run-holders, which are in all respects similar to those recorded thirty years ago by the Otago men (*vide* Buller's "Birds" and Hutton's "Animals of New Zealand").

There can be no doubt that the keas have wrought, and are still causing, great havoc among sheep in certain districts.

It may be worth noting that the statement frequently made (*vide* Wallace's "Darwinism") that they "go for the kidney-fat" especially is an exaggeration. Those men whom I have interviewed tell me that the kea will eat any part, even the entire carcase, of a sheep, leaving the bones clean; they are not such "gourmets" as has been supposed. W. B. BENHAM.

Dunedin, February 18.

A New Product of Actinium.

RECENT work has directed attention to the great similarity in the modes of transformation of actinium and thorium. Thorium, probably itself inactive, gives rise to radio-thorium (Hahn, *Jahrbuch d. Radioact. u. Elektron.*, ii., 3330) which emits α rays; radio-thorium forms thorium X, which is followed by the other well known products, the emanation and the active deposit. Actinium behaves in a very similar way. By the same method, which was successful in separating thorium X from thorium, Godlewski (*Phil. Mag.*, July, 1905) showed that a new

product, actinium X, could be separated from actinium. Actinium X produces the emanation, and this in turn the active deposit. The similarity between these two substances is even closer, for I have found that a new product is present in actinium which is intermediate between actinium and actinium X, and, from analogy to thorium, will be called for convenience "radio-actinium." This product emits α rays, is half-transformed in about twenty days, and is the parent of actinium X.

The separation of radio-actinium from an actinium solution in radio-active equilibrium can be often accomplished by producing a very small precipitate in the solution, which settles down slowly and carries with it the new product, while most of the actinium and actinium X remain in the solution. Amorphous sulphur was found to be very convenient for that purpose. To a fairly strong hydrochloric acid solution of actinium some sodium thiosulphate was added, and the small amount of sulphur was allowed to settle down in the cold. After filtration the precipitate was tested for activity. It showed a strong α-ray activity, but comparatively very little β-ray activity, and gave out very little emanation.

The α-ray activity steadily rises to a maximum after about three weeks, the activity then being about two or three times its initial value. The activity then decays and ultimately according to an exponential law, with a period of about twenty days. The β-ray activity and emanating power reach a maximum at the same time, and decay with the same period. This rise of activity to a maximum is due to the formation of actinium X from the radio-actinium. This is shown by the increase of the emanating power, and was also verified by direct separation of actinium X from the radio-actinium. For instance, if one separates the actinium X when the activity of the radio-actinium is decreasing, the activity of the residue again rises and varies in the same way as in the above described experiment. Actinium itself, freed from all its products, gives out practically no α or β rays, but then slowly increases in activity, reaching a maximum after about four months. Godlewski obtained almost inactive actinium, showing that he had unknowingly separated the new product from the actinium. I have observed that when dissolving actinium in hydrochloric acid, generally a small portion remains undissolved, and this fraction contains radio-actinium to a large extent.

Giesel long ago stated that his preparations of emanium increased in activity for about six months. This may probably be explained by the formation of radio-actinium. In a recent paper, Marckwald (*Ber. d. d. chem. G.*, 1905, 2264) compared the chemical properties of actinium and emanium, and concluded that actinium and emanium were not identical, but the latter was the parent of the former, the activity of his actinium decaying in the course of several months. This is in contradiction with Debierne's statement that his actinium does not lose its activity. The decaying substance, separated by Marckwald, which he concluded to be the actinium of Debierne, may possibly be the product radio-actinium, because a precipitation of thorium with sodium thiosulphate carries down the radio-actinium also. But it remains to be explained why his actinium did not rise at first, or why it did not seem to contain actinium X.

It may be mentioned that the above described experiments were carried out both with the actinium of Debierne and the emanium of Giesel. The same results were obtained in both cases.

A more complete account of these experiments will be given later. O. HAHN.

McGill University, Montreal, March 27.

The April Meteors.

THESE meteors will return this year at a favourable period, the moon being near new and only visible as a slender crescent for a short time before sunrise. If the atmosphere should prove clear during the night following Saturday, April 21, a number of Lyrids will probably be seen. The shower is likely to reach its best after midnight, when the radiant at $271^\circ+33^\circ$ will have attained a sufficiently high altitude to favour the visible distribution of its meteors.

The display is seldom very rich, and has not developed striking brilliancy since 1803, but it sometimes offers fairly conspicuous features, as in 1901. Usually it does not equal the strength of the annual Perseid shower of August, and it is certainly of much shorter duration, for its period of special activity is often confined to a few hours. In 1901 the Lyrids were pretty bright and plentiful on April 21, though on the previous night the display could be scarcely recognised during a long watch. An interesting feature of this system is that its radiant, like that of the August meteors, exhibits a daily motion eastwards amongst the stars. This displacement is, however, very difficult to trace owing to the brief duration of the shower, and to its comparative feebleness at many of its returns.

Observers would do well to watch attentively for early Lyrids on April 18 and 19, and for late members of the stream on April 22, 23, and 24 next. Individual meteors, accurately recorded on these dates, may be regarded as very valuable, since it will be possible to compare their paths with duplicate observations secured elsewhere, and thus their radiant points and heights in the air may be determined with trustworthy precision.

Meteors from streams contemporary with the Lyrids are usually somewhat rare, but in recent years two showers of slow-moving meteors have been well pronounced from southern positions at $189^\circ-31^\circ$ and $218^\circ-31^\circ$.

W. F. DENNING.

THE interesting Lyrid meteor shower passed unobserved last year owing to the generally unsatisfactory state of the weather that prevailed at the time of its expected appearance. In the event of better atmospheric conditions obtaining at the present epoch, the Lyrids are likely to be strongly in evidence, as the circumstances that regulate the intensity of these meteor apparitions will be exceptionally favourable. According to calculations by the writer, the Lyrid shower will fall in 1906 on the night of April 19, and will be visible at least in part from both sides of the Atlantic, though the main bulk of the display will descend over the American continent. The earlier maxima on April 19 fall due about 10h. 30m. and 14h. 30m. G.M.T.; the second and stronger phase of the shower will culminate at 19h. 30m., and will be followed by two other maxima, one of which occurs on April 19 23h. and the other on April 20 2h. The last and final outburst of meteoric activity will, of course, completely elude observations over the American continent. Of the minor showers associated with the period, the most prominent will be visible on the nights of April 23 and 25; on the former there is a well defined maximum at 13h., while on April 25 two or three maxima will take effect between 9h. and 12h. 30m. JOHN R. HENRY.

April 7.

Sea-sickness and Equilibration of the Eyes.

IN connection with the above subject, which Mr. Sang brought under the notice of your readers in your number for March 29, I would like to point out that it has been long known that the eyes may play an important part in sea-sickness. When making some investigations connected with a "New Variety of Ocular Spectrum" (Proc. Roy. Soc. Edin., vol. x.), I found that by acting on the eyes alone a very disagreeable sickness, similar to sea-sickness, could be easily produced. The subject was comfortably seated in a chair with his head in a large cylindrical box. The box was open below, but partly closed on the top by a circular piece of wood by which the box was suspended. The cylindrical sides of the box were made of tracing paper having broad black vertical bands painted on it. When the box was rotated on a vertical axis, the black and white vertical bars passed in succession in front of the observer. The effects on the subjects were various; sometimes they felt as if they were rotating in a direction the opposite of that of the box, but the most certain result was a very disagreeable sickness, which continued for some time after the experiment was made. Personally, I find the best preventive of sea-sickness is to lie down and read anything I may be interested in, holding the book in such a position that it shuts out the view of all other objects. JOHN AITKEN.

Ardenlea, Falkirk, N.B., March 31.

NOTES ON SOME CORNISH CIRCLES.[1]

II.

The Tregeseal Circles (lat. 50° 8′ 25″ N., long. 5° 39′ 25″ W.).

There are two circles situated on Truthwall Common near to Tregeseal and not far from St. Just; the one is nearly to the east of the other, and there are outstanding stones, including four holed stones, and several barrows. The eastern temple has a diameter of 69 feet, and includes, at the present time, nine erect and four prostrate stones; the original structure seems to have contained twenty-eight stones according to Lukis.

Photo. by Lady Lockyer.

Fig. 4.—The Eastern Circle at Tregeseal.

Photo. by Lady Lockyer

Fig. 5.—The Mên-an-tol.

My wife and I visited the region in January, 1906, but previously to our going Mr. Horton Bolitho, accompanied by Mr. Thomas, whose knowledge of the local antiquities is very great, had explored the region and taught us what to observe.

The chief interest appears to lie on the N.E. quadrant, where, in addition to a famous longstone on a hill about a mile away, the nest of holed stones and several of the barrows are located. Carn Kenidjack, a famous landmark, lies to the north.

Of the two circles, I confined my attention almost exclusively to the eastern one, as the other is in a fragmentary condition, though it is still traceable. It is hidden almost entirely from the eastern circle by a modern hedge.

Mr. Horton Bolitho, who accompanied us in January, has again visited the spot, with Mr. Thomas, for the purpose of further exploration, and determining the angular height of the sky-line along the different alignments, which I have plotted from the 6-inch and 25-inch maps. My readers will therefore see that my part of the work has been a small one, and that they are chiefly indebted to those I have named.

No theodolite survey has as yet been made for determining the azimuths and the height of hills. The following approximate azimuths have been determined by myself from the 25-inch map, and the elevations by Mr. Horton Bolitho by means of a miner's dial.

Alignments	Azimuth	Elevation
Apex of Carn	N. 12° 8′ E.	4° 0′
Barrow 800′ distant	N. 20 8 E.	3 50
Two barrows 900′ distant	N. 50 8 E.	1 50
Holed stones	N. 53 20 E.	1 15
Longstone	N. 66 38 E.	2 10
Stone	N. 76 13 E.	

The carn referred to in the above table is Carn Kenidjack, called "the hooting cairn." The rocks on the summit, in which there is a remarkable depression, are still by local superstition supposed to emit evil sounds by night.

[1] Continued from p. 367.

Of the sight-lines studied so far, those to and from the Longstone and the holed stones seem the most important. The Longstone,[1] $1\frac{1}{2}$ miles to the N.E., is a monolith 10 feet high on the western side of a hill; it is visible from the circle though furze has grown round and partly hidden it.

The meanings of the various alignments seem to be as follows:—

	Dec. N. ° ′ ″	Star	Date
Apex of Carn	42 33	Arcturus ...	2330 B.C.
Barrow 800′ distant	40 29	,, ...	1970 ,,
Two barrows 900′ distant	25 20 21	? Solstitial	
Holed stones	23 2 20	? ,,	
Longstone	16 2	May sun	
Stone	9 15	Pleiades ...	1270 B.C.

Regarding the possible solstitial alignments, the declinations obtained may be neglected until the azimuths and angular heights of the hills have been determined with a good theodolite. A change of −10′ in the angular elevation, and hence about that in the resulting declination, would bring the date given by the barrows to about 2000 B.C.

The position of the Longstone is well worthy of attention. Several very fine monuments which mark the surrounding horizon are visible from it in azimuths with which other monuments have made us familiar. They are as follows:—

Alignment	Az.	Hills
Longstone to Mên-an-tol ...	N. 50° 30 E. ...	0 34′
,, 9 Maidens (Boskednan)	N. 54 0 E. ...	1 0
,, W. Lanyon Quoit	N. 67 0 E. ...	0 0
,, Lanyon Quoit	N. 72 45 E. ...	0 0

These values, of which the angular heights of the hills were determined approximately from the contours on the 1-inch Ordnance map, lead us to the following declinations:—

Alignment	Dec.	Star	Date
Longstone to Men-an-tol	24° 7 N. ...	Solstitial sun	
Longstone to 9 Maidens (Boskednan)	22 37 N. ...	Solstitial sun	
Longstone to W. Lanyon Quoit	14 3 N. ...	May sun	
Longstone to Lanyon Quoit	10 30 N. ...	Pleiades ...	1030 B.C.

[1] In Cornwall this is the name generally given to a monolith.

The May-sun alignment, it may be noted, differs from that from the circle. The heights of hills when determined may give us the same solar declination; that now used gives the declination of the sun for April 28 and August 15 in our present calendar.

Regarding the alignment on Lanyon Quoit, it need only be pointed out that the Pleiades date obtained is some 200 years after the date obtained for the analogous alignment from the circle, showing that if these two monuments—the Tregeseal circle and the Longstone—have any relationship, the removal to the high plain, now known as Woon Gumpus and Boswen Commons, was an afterthought improvement.

I next come to the holed stones, not only the nest of them not far from the circle, but the famous Mên-an-tol itself.

I had heard before going to Tregeseal that the four holed stones shown on the Ordnance map had been knocked down and set up again (not necessarily in their old places) two or three times. Mr. Horton Bolitho and Mr. Thomas, however, in their examination were convinced that the largest of them has never been moved. They also express the belief that the others are not more than a foot or so from their original positions, and that this change is only due to their re-erection by Mr. Cornish after they had fallen down. So far I have heard nothing of the direction of the hole in the stone which retains its original position.

Another interesting matter is that the explorers in question were able to trace an ancient stone alignment from the circle to the holed stones.

I have long held that these holed stones were arrangements for determining an alignment. The famous Odin stone at Stenness, long since disappeared, was, if we may trust the very definite statements made about its position, used to observe the Barnstone in one direction and the chief circle in the other.

The azimuths suggest that theodolite measures may show that the Tregeseal stones might have been used in the same way; they, the Longstone and Lanyon quoit, are in nearly the same straight line, the alignment, holed stones to Longstone and Lanyon quoit, being N. 67° E., so that the May sunrise may have been noted in this way.

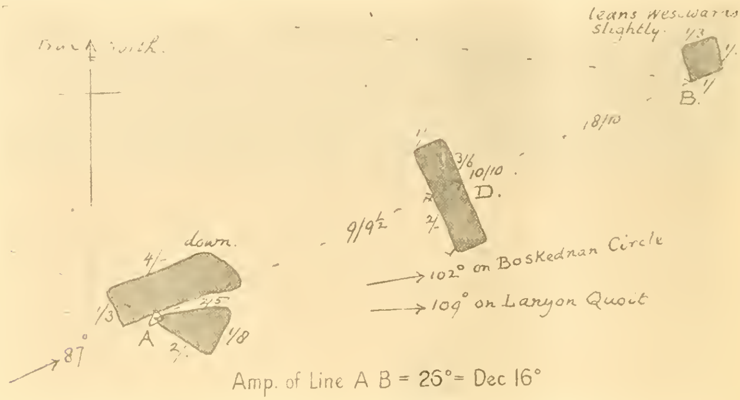
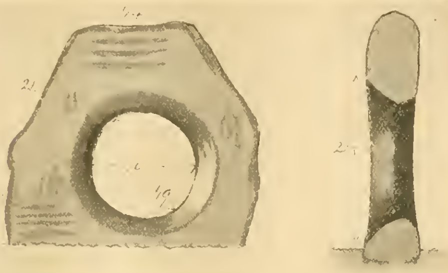


FIG. 6—Plan of the Mên-an-tol from Lukis, showing that it was an apparatus for observing the sunrise in May and August in one direction and the sunset in February and November in the other. Sun's declination. 16 N. or S.

Several other monuments, *e.g.*, Chûn Castle and Cromlech, are to be found in the immediate neighbourhood of the Tregeseal Circle and the Longstone,



D. LOOKING S.W.　　SECTION OF D.

SCALE 1 INCH TO 1 FOOT

Fig. 7.—The Mên-an tol'. Front view and section, from Lukis.

but these will have to await further investigation as to their character and antiquity before any conclusions concerning their astronomical use can be deduced.

NORMAN LOCKYER.

IRRIGATION IN THE TRANSVAAL.[1]

THERE are few subjects on which such a great diversity of opinion exists as on the administration of South Africa. Free labour and Chinese labour, the electoral franchise of the Transvaal, the various routes from the interior to the coast, the language to be adopted in Government schools—on these and on many other points one hears well-informed and perfectly honest-minded people asserting, and that with considerable warmth, the most opposite views; views which they maintain are founded on facts.

But there is one subject on which it may be asserted all are agreed, and that is that the great want of South Africa is not gold or diamonds, but water in sufficient volume to be spread over the land when and where it is required. Not that the country is generally devoid of rain, but, as it has been well put, "When rain is wanted it is generally not there; when it is not wanted it is invariably present."

No one was more fully alive to this want than the late distinguished High Commissioner, Lord Milner. He borrowed the services of Sir William Willcocks, one of the most prominent members of the small band of English hydraulic engineers from India who have done so much on the Nile. He further procured two engineers, Messrs. Gordon and Strange, thoroughly trained in the excellent irrigation school of India, to advise, one in the Cape Colony and the other in the Transvaal, upon irrigation matters. Willcocks's tour took place during the war, when he was much hampered by the difficulty of getting about the country. His visit, also, was a short one, but not too short to prevent his submitting a very able report full of thoughtful suggestions. Gordon and Strange went to South Africa after the war. They are there still, and may render invaluable services to the country if the agricultural classes can be made to believe that they have anything to learn, and that there may be advantages in accepting a scheme which requires all to submit to certain restrictions for the benefit of all, instead of each farmer being free to follow his own devices. A distinguished member of the present Cabinet has remarked that the Boer farmer seems to have a perfect instinct for disobeying the law. Unless he learns to substitute for this instinct the dictates of reason, there is little hope of irrigation flourishing in South Africa.

Besides procuring the services of these officers, Lord Milner shortly before leaving South Africa appointed a commission to report on the legislation required to enable the water resources of the Transvaal and Orange River Colony to be thoroughly utilised, and also on "the precautions necessary in dealing with subterranean water, more especially in areas situated on the dolomite formation, so as to prevent as far as possible the diversion of such water from public streams and fountains to the detriment of the public."

It was directed that an interim report should be submitted as soon as possible on this last subject. This report, dated May 20, 1905, is now before us. The commission consisted of Mr. Justice Wessels, Judge of the Supreme Court of the Transvaal, three other Dutch and two English gentlemen, one of whom was Mr. Strange.

The commission has collected a large mass of interesting information and opinions from thirty-one witnesses, of whom no fewer than nine were professional geologists. South Africa is to be congratulated in possessing so many scientific gentlemen whose evidence was of great value. The other witnesses were principally engineers and farmers. Of the latter there were seven.

In framing an irrigation project the two first questions to ask are generally, How much land is it proposed to irrigate? How much water is available to irrigate it? In all but the most favoured countries the area which it is desired to water far exceeds the volume of water available. In the Transvaal the irrigable area can easily be marked out. It is not so easy to say how much water is at our disposal.

Usually irrigation is practised by canals and watercourses drawn from rivers and lakes, natural or artificial. By careful observation one finds how much water, at the season when irrigation is required, can be drawn from the river or lake. Elsewhere irrigation is practised by pumping water from wells, going down to the water-bearing stratum. Such a stratum is usually found in alluvial plains at no very great depth, and wells may be sunk within a few hundred yards of each other without causing injury by one exhausting the other. The recent Indian Irrigation Commission found that in that country about 13 millions of acres were yearly watered in this way.

The peculiarity of the situation on the dolomite formation of the Transvaal is that the subterranean water tapped by the boring rod is not due to the rain which falls vertically on the surface of the land above, but that the whole of the limestone substratum is pierced by holes and tunnels, flowing streams, and stagnant reservoirs, so that if water be pumped from a well there is no certainty that another well situated ten miles off may not be thereby sucked dry.

Ultimately the water finds its way out to the surface through springs discharging at times more than 50 cubic feet per second. It seems evident that the catchment basins of these subterranean waters do not necessarily correspond with those of the earth's surface above, and the problem of defining their limits and

[1] "Inter-Colonial Irrigation Commission." Interim Report. Pp xxxvii + 166. (Pretoria: Government Printing and Stationery Office, 1905.) Price 7s. 6d.

calculating the volume of the water that may be drawn from them is not an easy one. Nor is it rendered more easy by the spirit evinced by the Boer farmer witnesses.

Three of the honoured name of Erasmus (two brothers and the son of one of them) refused to recognise any difference between the ownership of water flowing under his ground and of metals found there. Pressed again and again to see the difference between picking up a diamond found on his lands and pumping away the water drawn in from the lands of others, the reply of one of the farmers was quite clear:—"I consider that it is a bad principle when a man owning land under a properly registered title in any country cannot take full advantage of the profit he is able to make."

Not only did these farmers claim the right to use all the water they could suck into their pumps and employ in irrigating their own lands, but they also insisted on their right to sell to their neighbours the water they did not require themselves.

It might happen, then, that the owner of a small pump large enough for his own fields might find his water supply cut off by a larger pump in his neighbour's farm, and he might have to buy from the owner of this large pump the water that had hitherto been his own.

The situation is evidently a difficult one. If such a case were to occur in India it would probably be ruled that a very careful scientific survey should be made of all the subterranean channels with the view of finding exactly how the waters flow, and that until this point was cleared up farmers should have a restriction put on the area of their lands which they were allowed to irrigate. Probably no one would be wronged if they were each limited to irrigating two-thirds of their farms. But this would require a stronger Government than is ever likely to rule in the Transvaal. Probably the commissioners are right in the recommendations they make, and they know that none more drastic would have a chance of being adopted.

These recommendations, after providing for the wants of towns and of mine owners, are to the effect that farmers should be allowed to pump freely for their own use for watering cattle or for irrigation.

"That traffic in underground water should be prohibited, and that an owner should not be allowed to sell or barter underground water which he does not require for his own use." "That it is unnecessary to prove that water in the dolomite formation flows in channels . . . and that if the Judge thinks that the facts establish a connection between the pumping and the diminution of the water in a stream he can prevent the pumping to such an extent as he thinks fit."

This last recommendation is a most important one. Will the Transvaal judges have the courage to carry it into effect?

Since the above was written, an interesting notice has appeared in Nature of March 1 (p. 426). From this it seems that the subject of underground waters has been occupying attention in the United States. The law there seems to favour the view of the Boer farmer, viz., that the owner of the surface of the land is equally owner of all that lies directly below that surface, whether it be rock, stagnant water or running water. This law is, however, receiving severe shocks from the advance of geological knowledge, and as means have now been found of measuring the flow of subterranean water it is probable that the law may be conformed to what is clearly only justice, and a landowner will not be permitted to take more than his due share of the water that passes under his soil.

THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION AT YORK.

The fourth meeting of the British Association in York will be held in that city on August 1–8, the date being fixed earlier than usual to enable members and their hosts to combine attendance at the meeting with a subsequent tour abroad or a visit to the northern moors for the shooting season. The association was founded in York in 1831, and had for its first president the Earl Fitzwilliam, F.R.S. It celebrated its jubilee there in 1881, under the presidency of Lord Avebury, then Sir John Lubbock, and it now meets again, after three-quarters of a century, in the city of its birth.

At the inaugural meeting on Wednesday, August 1, Prof. E. Ray Lankester, F.R.S., president-elect, will assume the presidency and deliver an address. On Thursday, August 2, there will be a soirée; on Friday, August 3, a discourse on "Volcanoes" will be delivered by Dr. Tempest Anderson; on Monday, August 6, a discourse on "The Electrical Signs of Life, and their Abolition by Chloroform," will be delivered by Dr. A. D. Waller, F.R.S.; on Tuesday, August 7, there will be a soirée; and on Wednesday, August 8, the concluding meeting will be held.

The sections and their presidents are as follows:—(A) *Mathematical and Physical Science*, Principal E. H. Griffiths, F.R.S.; (B) *Chemistry*, Prof. Wyndham Dunstan, F.R.S.; (C) *Geology*, Mr. G. W. Lamplugh, F.R.S.; (D) *Zoology*, Mr. J. J. Lister, F.R.S.; (E) *Geography*, Sir G. D. Taubman Goldie, K.C.M.G., F.R.S.; (F) *Economic Science and Statistics*, Mr. A. L. Bowley; (G) *Engineering*, Dr. J. A. Ewing, F.R.S.; (H) *Anthropology*, Mr. E. Sidney Hartland; (I) *Physiology*, Prof. Francis Gotch, F.R.S.; (K) *Botany*, Prof. F. W. Oliver, F.R.S.; (L) *Educational Science*, Prof. M. E. Sadler.

To the antiquarian York has preeminent attractions, its Roman remains, its mediæval bars and walls, which still encircle the greater part of the city, its Norman castle and noble minster, being each objects of special interest. The city also contains several manufactories interesting to scientific men; opportunities will be given for visiting these under skilled guidance in the afternoons, after the meetings of the sections. Excursions will be organised to several places of interest.

The neighbourhood of York, though flat, presents many objects of geological and archæological interest, many of which are reached by good level roads; cyclists are therefore recommended to bring their machines with them to the meeting.

It is hoped that it may be possible to arrange for an exhibition of photographs taken by the members in South Africa, for which the reception room affords ample accommodation.

York enjoys exceptional railway facilities, being under four hours from London, five hours from Edinburgh. The various railway companies will issue return tickets, at a single fare and a quarter, from the principal stations in the United Kingdom to York. These tickets, which will be available from July 31 to August 14, may be obtained by members and associates attending the meeting on presentation of a certificate signed by one of the local secretaries. The North-Eastern Railway Company will also issue periodical tickets to members and associates, at cheap rates, for going and returning as often as desired during the time of the meeting between York and the chief places in the district.

An attempt may be made, provided sufficient support is forthcoming, to arrange at the end of the meeting a yachting excursion, lasting two or three weeks, to

Norway or other interesting district, limited to association ticket-holders.

A handbook dealing with the natural history and archæology of the York district has been specially written for the occasion, and a copy will be presented to each member of the association.

It is anticipated that there will be a large amount of private hospitality, and as so many members were unable to visit South Africa last year it is expected that there will be a very large meeting.

THE ERUPTION OF VESUVIUS.

THE activity of Vesuvius, incessant for some time past, has culminated in an eruption which, making every allowance for newspaper exaggeration, stands in the foremost rank of historic eruptions, even if it is not already the greatest of all. It is not yet at an end; we cannot say that it has reached its climax; but the interest excited is so great that some forecast of the future, so far as this is possible, may be attempted.

The late Prof. John Phillips pointed out that the volcanoes of the Phlegræan fields have had two periods of activity, each lasting about four hundred years, and that Etna has also had two great periods of activity, the first of which lasted about 800 years, reaching its maximum in the second century B.C., while the second, commencing about the fourteenth century, had attained its maximum about the end of the eighteenth, after which eruptions declined in violence and frequency; from this he concluded that a period of 700 or 800 years may be assigned to the periods of volcanic activity of Etna. It is probable that in all cases of volcanic activity there is some such period, in which the eruptions, spasmodic at first, increase gradually in frequency until they attain a maximum, and then die out again, the length of the period being determined by the size of the reservoir of molten rock which gives rise to the eruptions; but there is not as yet any means of determining what will be the duration of the present series of Vesuvian eruptions, or whether it has reached its maximum; all that seems certain is that there are no signs of this being passed.

Between A.D. 79, when Pompeii was destroyed, and 1631, eleven great eruptions were recorded; the seventeenth century gave four, the eighteenth twenty-three, and in the nineteenth, up to 1869, the date of Prof. Phillips's work, twenty-four were recorded. After that date there was the great eruption of 1872, and an almost continuous condition of activity ever since. It may be that we have now reached the climax, or the future may have catastrophes in store still greater than that which we are now witnessing; but, if there is any virtue in analogy or inference, centuries must elapse before the mountain resumes that condition of quiescence which existed before our era, and for prolonged periods in the centuries which followed its commencement.

The length of these periods of volcanic activity and the difference between those of neighbouring volcanic centres shows that the cause lies deep in the earth, and that the conditions are beyond our ken. Prophecy must necessarily be vague, and can do no more than indicate the future course of events in the most general and guarded terms; yet mankind will always want to peer into the future. Attempts will be made to predict the time of coming eruptions, and not wholly without justification, for extra-mundane conditions must, to some slight extent, influence the manifestations of volcanic activity. Prof. Palmieri believed that there was a distinct increase in the activity of ejection from the cone and in the abundance of the lava at the new and full moon, and it is possible that a connection exists with cycles of variation of climate, magnetic force, or the frequency and distribution of certain solar phenomena, but the relation may be only of the nature of the proverbial last straw that broke the camel's back. On occasion it may do so, but though sometimes the camel can bear many more straws, at others he has given way before even one was added to his load; and so it is with volcanoes. The cause of their eruptions is so preponderatingly mundane that any slight effect of extra-mundane causes must be elusive, difficult to establish, and only to be detected by the study of a long series of averages. For purposes of prediction they are of little use. There is, however, some comfort for the immediate future in the reported subsidence of Pozzuoli; if real, this probably indicates that the present paroxysm has reached its climax, and will now slowly cease.

From the Press reports of the eruption, the following particulars of scientific interest have been extracted and arranged as a diary of events:—

April 5.—Vesuvius in strong activity. Great blocks of rock hurled as far as the lower station of the funicular railway.

April 6.—The new crater began to emit lava in an abundant stream. The lava has arrived within three or four miles of the village of Bosco-Trecase.

April 7.—Bosco-Trecase destroyed. After midnight loud rumblings were heard, followed by a violent earthquake shock, which shattered the windows in the town. Then lava began flowing from Ciaramella, where a fresh fissure had opened up a few days previously. From the Ciaramella crater masses of incandescent rock were ejected, and a torrent of lava swept down at a terrific speed, flowing in two streams, one 200 yards broad moving towards the centre of the town. The town had hardly been evacuated when the lava invaded the houses, several of which were burned down, and soon Bosco-Trecase seemed to be enveloped in flames. At 6 a.m. Bosco-Trecase was completely surrounded by a stream of lava. The cone on the Pompeii side of Vesuvius collapsed, and on the opposite side a new crater opened at the base of the cone in the Atrio del Cavallo and vomited lava and stones. The principal crater was in violent eruption. Explosions were unceasing. A shower of grey-black ashes fell in the streets of Naples.

April 8.—Central crater of Vesuvius was again emitting quantities of lava. Repeated explosions were followed by subterranean rumblings and by earthquake shocks, which were distinctly felt in the villages at the foot of the mountain. At 12.31 a.m. a slight shock of earthquake was felt at Naples, and a second at 2.10 a.m., both disturbances being accompanied by rumblings. A telegram from Naples at 6.30 p.m. announced that Ottajano, Poggio Marino, and Somma had been entirely abandoned. At Ottajano the lava was flowing 7 feet deep through the streets. At 8 p.m. the flow of lava seemed to be generally somewhat slackening. A shower of black dust, like iron filings, fell throughout Montenegro, covering the surface of the country to a depth of a millimetre with an iron-grey layer. Prof. Mattucci, director of the Vesuvius Observatory, made the following report:—

"The eruption of Vesuvius has assumed extraordinary proportions. Yesterday and last night the activity of the crater was terrific and ever increasing. The neighbourhood of the observatory is completely covered with lava. Incandescent rocks are thrown up by the thousand to the height of 2400 feet, and even 3000 feet, and fall back, forming a large cone. Another stream of lava has appeared from a fissure the position of which is not well defined. The noise of the explosions and of the rocks striking together is deafening. The ground is shaken by strong and continuous seismic movements. The seismic instruments threaten to break, and it will probably be necessary to abandon the observatory, which is very much exposed to electric shocks. The telegraph is interrupted, and it is believed that the funicular railway has been destroyed."

April 9.—The stream of lava in the direction of Torre Annunziata has remained stationary since yesterday evening. The dynamic action of the volcano appears to be

diminished considerably, and the situation now seems to be more satisfactory. The shower of ashes has ceased to pour on Naples. The atmospheric conditions are unfavourable, and the seismic instruments last night registered several earthquake shocks. A steamer with 1000 persons on board left Capri this morning for Naples, but was unable to reach her destination, as when about a mile off the coast the passengers were nearly suffocated by falling cinders and ashes, and the vessel has anchored here so as to enable the passengers to witness the eruption.

Vesuvius Observatory, 6.30 p.m.—Report from Prof. Mattucci:—"The explosive activity of Vesuvius, which was very great yesterday and was accompanied by very powerful electric discharges, diminished yesterday evening. During the night the expulsion of rocks ceased, but the emission of sand increased, completely enveloping me and forming a bed more than ten centimetres deep, which carried desolation into this elevated region. Masses of sand gliding along the earth created complete darkness until 7 o'clock. Several blocks of stone broke windows of the observatory. Last night the earthquake shocks were stronger and more frequent than yesterday, and displaced the seismic apparatus. Yesterday afternoon and this morning torrents of sand fell. While I am telegraphing several balls of fire rise with loud rumbling from the enlarged craters and the new elevated crevasses."

April 10.—Report from Prof. Mattucci:—"Last night was calm except for a few explosions of considerable force from time to time. At 4 o'clock this morning the explosions became more violent. The seismic instruments of the observatory record strong disturbances in the interior of the mountain." The roof of the market of Monte Oliveto, Naples, fell in, on account of the accumulation of volcanic ash upon it.

NOTES.

At a meeting of the council of the Royal College of Surgeons of England held on April 5, the Walker prize of 100*l*., founded by the late Mr. C. C. Walker to encourage investigation into the pathology and therapeutics of cancer, was awarded to Prof. C. O. Jensen, of Copenhagen. The committee appointed to advise the council in reference to the award of the prize was influenced, not merely by the actual work which Prof. Jensen has done in investigating the nature of cancer and the effect of treatment upon it, but also by the extent to which he has opened up a field of research to those engaged in the study of cancer on certain lines, enabling them to carry out their investigations over longer periods of time and under better and more determined conditions than have up to the present time been possible. The Jacksonian prize for 1905 was awarded to Mr. R. C. Elmslie for his essay on "The Pathology and Treatment of Deformities of the Long Bones due to Disease occurring during and after Adolescence." The prize-subject for the year 1907 will be "The Operative Surgery of the Heart and Lungs, including the Pericardium and the Pleura." The subject selected for essays to be submitted in competition for the Cartwright prize for the period 1906–1910 was "Prevention of Dental Caries." The honorary medal of the college was awarded to Lieut.-Colonel Sir Richard Havelock Charles, I.M.S., in appreciative recognition of his gift of anthropological specimens—an addition to the museum of special value and importance, not only on account of the number and variety of the specimens presented, but also because of the authentic particulars attached to them.

At a meeting of the Royal Geographical Society on Monday, Mr. Whitelaw Reid, the United States Ambassador, presented to Captain R. F. Scott, R.N., C.V.O., the gold medal of the American Geographical Society, in recognition of his sledge journey on Antarctic ice and the work of the National Antarctic Expedition.

The secretary to the Post Office has informed the Decimal Association that letters addressed to France and Germany, weighing more than ½ oz. but not more than 15 grams, if only stamped 2½*d*., are not surcharged. Although the difference in weight is but small (about 5 per cent.), still the fact should be generally known, because letters are frequently stamped with 5*d*. which, under this ruling of the Post Office, would go for 2½*d*.

Courses of instruction in oceanic research will be held, as in former years, in Bergen, during the university vacation (August 8 to October 15), mainly on the lines previously adopted. The courses will consist partly of lectures, partly of practical instruction and assistance in laboratory work; excursions will also be made, during which the use of various appliances and instruments will be practically demonstrated. The course will be conducted by Dr. A. Appellöf, Dr. D. Damas, Mr. B. Helland-Hansen, Mr. E. Jørgensen, and Mr. C. F. Kolderup. Anyone desiring to attend the course should make application to the Oceanographical Institute of Bergen Museum, Bergen, Norway, before July 1.

A deputation waited upon Mr. Lloyd-George, M.P., President of the Board of Trade, on Monday to urge the necessity for further amendment of the patent law by legislation which would enforce in the United Kingdom the forfeiture of all British patents for inventions which were worked without, but not within, the United Kingdom, after the lapse of three years from the date of application in the country of origin unless the patentee could justify his inaction to the Board of Trade. In the course of his reply to the views placed before him by members of the deputation, Mr. Lloyd-George pointed out that the Patent Act of 1902 embodied the principle of compulsory working, and he wished to know where the Act had broken down. He thought it necessary to see that, while the commercial community was protected, protection was also afforded to those poor people who, while they have the brains, have not the cash to enjoy the full benefit of their ingenuity.

A committee has been appointed to inquire into and report upon matters connected with the Department of Agriculture and Technical Instruction for Ireland. The committee is constituted as follows:—Sir Kenelm Digby, late Under-Secretary for the Home Department (chairman); the Hon. John Dryden, late Minister of Agriculture in Ontario; Mr. W. L. Micks, member of the Local Government Board for Ireland; Mr. F. G. Ogilvie, principal assistant-secretary for technology in the Board of Education; and Mr. Stephen Brown, chairman of the Kildare County Council. The committee is to inquire whether the provisions of the Agriculture and Technical Instruction (Ireland) Act, 1899, constituting the department, and the methods which the department has followed in carrying out those provisions, have been shown by experience to be well suited to the conditions of Ireland; whether any, and if so what, changes are desirable in those provisions and methods; and to report also upon the relations of the department to the Council of Agriculture, to the Agricultural Board, and to the Board of Technical Instruction; upon its relations to local statutory bodies; upon the funds at its disposal and the modes of employing them, and upon its position in regard to other departments, especially those charged with educational functions.

From the April number of the *Popular Science Monthly* we learn that the regents of the Smithsonian Institution have passed a resolution expressing their profound sorrow

at the death of Dr. S. P. Langley, secretary of the institution from 1887 to his death. The resolution includes the following appreciative record of Dr. Langley's work:—"In the death of Mr. Langley this institution has lost a distinguished, efficient, and faithful executive officer, under whose administration the international influence of the parent institution has been greatly increased, and by whose personal efforts two important branches of work have been added to its care—the National Zoological Park and the Astrophysical Observatory. The scientific world is indebted to Mr. Langley for the invention of important apparatus and instruments of precision, for numerous additions to knowledge, more especially for his epoch-making investigations in solar physics, and for his efforts in placing the important subject of aërial navigation upon a scientific basis. All who sought the truth and cultivated science, letters, and the fine arts, have lost through his death a co-worker and a sympathiser." The executive committee has been requested to arrange for a memorial meeting to be held in Washington; and Dr. A. D. White has been invited to prepare a suitable memorial which shall form a part of the records of the Board of Regents of the institution.

The belemnites of the Speeton Clay form the subject of a paper by Mr. T. Shepherd, issued as No. 29 of Hull Museum Publications.

We have received a copy of a fourth supplement to "A Catalogue of the Books in the Library of the Indian Museum," containing additions from the autumn of 1899 to that of 1903.

In No. 1440 of the Proceedings of the U.S. National Museum, Mr. Knud Andersen describes horseshoe-bats collected in the islands of Nias and Engano, Malay Archipelago. No. 1441 of the same serial is devoted to a revision of American Palæozoic insects, by Mr. Anton Handlirsch, of the Imperial Natural History Museum at Vienna, to whom the Transatlantic specimens have been sent. A large part of the collection was obtained from the Upper Carboniferous shales of Mazon Creek, in Illinois, where they are found imbedded in washed-out nodules. Since only about one nodule in a thousand contains an insect's wing, the search would be impossible were it not for the fact that other fossils are comparatively common. Owing to ill-health, Prof. Scudder was unequal to the task of describing the collections, and it was for this reason that they were handed over to the Austrian palæontologist. The systematic conclusions reached by Mr. Handlirsch differ somewhat from those of Prof. Scudder, and render insect phylogeny simpler. The order of Palæodictyoptera, which is the oldest, is regarded as the ancestral stock from which all other insects are descended. In No. 1439 of the same serial Mr. Handlirsch describes a new and interesting type of cockroach from the Cretaceous beds of the Judith River, Montana.

Parts iv. and v. of vol. xvi. of the Proceedings of the Royal Physical Society of Edinburgh have been received. The former is entirely devoted to a catalogue of the crustaceans of the Forth area, by Dr. T. Scott; while certain rotifers from the same district form the subject of a paper in No. 5, by Mr. J. Murray. The latter issue also contains an important paper by Prof. J. G. Kerr on the embryology of certain primitive fishes, more especially the lung-fishes and fringe-finned ganoids. As the result of his investigations, the author concludes that vertebrate limbs are probably modified external gills, the theory that they are derivatives from a pair of lateral skin-folds being, in his opinion, purely hypothetical, and not supported by embryological evidence. According to Prof. Kerr's view, two pairs of the primitive gills lost their respiratory function and assumed a motor one, developing at first into "stylopterygia," then into the "archipterygia" of Ceratodus, and finally, but independently, into "chiropterygia." This implies the theory that the archipterygium is really the primitive type of fin, and also involves the acceptance of Gegenbaur's idea that limb-girdles represent branchial arches. The limbs of Lepidosiren and Protopterus are regarded as reversions to the stylopterygian type. Further, the author asserts his belief in the intimate relationship between lung-fishes and salamanders. Dollo's theory that the diphycercal tail of modern lung-fishes is derived from a heterocercal type is considered improbable.

We have received copies of the *Sitzungsberichte* of the Royal Bohemian Academy of Sciences for 1904 and 1905. One of the most interesting articles in the former of these is an account, by Dr. G. Eisen, of the now extinct Indians of the Santa Barbara Islands, off the Californian coast. Our knowledge of these Indians is derived from the accounts of the early voyagers, from the missionaries who subsequently settled on the islands, and from the remains in their refuse-heaps and the skulls and skeletons which have from time to time been collected. Some of the islands probably at one time had a population approaching 1000 each, but in 1823 only about 900 were left on Santa Barbara and the neighbouring islets; and by 1875 all had disappeared, the last survivor in San Nicolas having been deported in 1853. Although they manufactured a certain number of domestic utensils, these Santa Barbara Indians are described by the missionaries as the most degraded of all human beings, with a morality lower than that of animals. Insects, especially grasshoppers, formed a portion of their food, and, like the natives of the adjacent mainland, they probably fed to a great extent on the larger kinds of earthworms. Possibly they belonged to the Shoshonean stock of the mainland. Their extermination is attributed to the changed conditions of existence imposed upon them by the missionaries.

In *Science* for March 9 and 16 several papers on yellow fever, read before the American Association for the Advancement of Science, are reported. Prof. Calkins discusses the protozoan life-cycle, and concludes that the yellow-fever microbe probably belongs to the spirochætes. Mr. J. H. White summarises the practical results of discoveries on yellow fever transmission, Mr. H. C. Weeks discusses the practical side of mosquito extermination, and Dr. J. Carrol, in a paper entitled "Without Mosquitoes there can be no Yellow Fever," reviews the evidence, showing that yellow fever is conveyed solely by the mosquito *Stegomyia fasciata*.

In the first number of the *Philippine Journal of Science*, issued in January, Mr. E. B. Copeland, discussing the water relations of the coco-nut palm, attributes much value to an open position where transpiration is considerable and the trees receive full illumination. These observations would help to explain the fact that coco-nut trees growing near the sea shore produce more fruit than those growing further inland, although analyses show very little differences in the composition of the soils.

The second number of the *Philippine Journal of Science* (i., No. 2) maintains the high standard of its predecessor. Mr. H. S. Walker discusses the keeping qualities of coco-

nut oil and the causes of its rancidity; the latter seems to be due to the growth of moulds in imperfectly dried copra. Mr. C. S. Banks describes and illustrates the principal insects attacking the coco-nut palm, and Mr. A. M. Clover writes on Philippine wood oils. Mr. W. D. Smith describes certain Orbitoides from the Binangonan limestone, and Dr. R. Strong experiments on vaccination against plague. Mr. M. Herzog details an investigation on beri-beri, from cases of which he has succeeded in isolating the kakke coccus of *Okata kokubo*.

In the *Bulletin du Jardin impérial botanique* of St. Petersburg (vol. vi., part i.) Mr. A. Elenkin puts forward the view that in lichens the algal and fungal constituents do not exist for mutual benefit, but, being differently acted on by external factors, one flourishes at the expense of the other. Mr. B. Issatchenko, writing on the conditions under which chlorophyll is formed, dissents from the results obtained by Mr. W. Palladin that a concentration of 35 per cent. to 50 per cent. of sugar prevents its formation. Mr. P. Isuzew announces that he has found trees of the bird-cherry with rose-coloured flowers in the province of Perm, and also that early and late flowering varieties were observed growing side by side.

In the *West Indian Bulletin*, vol. vi., No. 4, a number of papers on sugar and sugar cultivation are collected from which a fair idea of the state of the industry in the West Indies can be obtained. While it cannot be said that the industry has been as yet re-established on a sound basis, the opinions expressed by such capable judges as Sir Daniel Morris, Dr. F. Watts, and Dr. H. H. Cousins all point to a successful future if only planters will take advantage of the improved varieties, and if separately or in combination they will arrange for the establishment of factories equipped with modern machinery. New seedlings giving a higher proportion of saccharose are being evolved; the well known seedling B. 208, now under cultivation in Barbados, Jamaica, Queensland, and elsewhere, has been surpassed by another Barbados seedling, B. 1529, and some of the Jamaican seedlings of 1904 promise to give excellent results. The fluctuations of the sugar industry in Antigua and St. Kitts during the last twenty-five years can be readily followed from the diagrams given by Dr. F. Watts.

An important contribution to the subject of foliar periodicity in tropical countries is provided by Mr. H. Wright in the Annals of the Royal Botanic Gardens, Peradeniya, vol. ii., part iii., 1905, recording a large number of interesting observations. Contrasting the influence of internal and external factors, two arguments in favour of the former are found in the small number of species that pass through a leafless period each year, and the striking fact that there is not a month in the year when all the deciduous species are in full leaf. On the other hand, since more than half the deciduous species pass through their leafless phase during the dry period from January to March, it is obvious that climate has considerable influence on periodicity. Of the physical factors that produce climate, Mr. Wright attributes the greatest importance to humidity. In this connection, the curves of monthly variations of temperature, rainfall, and humidity placed alongside the curve indicating the number of deciduous species in each month are especially instructive.

A very elaborate discussion of the climate of Beyrout, Syria, has been undertaken by Dr. S. Kostlivy, and published by the Royal Bohemian Society of Sciences. Since the year 1876 the observations have been regularly printed in the year-books of the Austrian Meteorological Service; the discussion in question refers to the twenty-five years 1876–1900. We can only briefly mention some of the principal results of Dr. Kostlivy's valuable work. The yearly variation of the monthly means of atmospheric pressure is considerable; the highest monthly mean was in January, 1898, 30·18 inches; the lowest in July, 1893, 29·70 inches, the mean variation being about half an inch. The highest monthly mean temperature occurs in August, 81°·5, the lowest in January, 55°·4. The absolute extremes were 101°·3, in October, 1898, and 30°·0, in December, 1897. The mean annual rainfall is 35·65 inches; of this amount 59·8 per cent. falls in winter, 18·5 per cent. in spring, 0·7 per cent. in summer, and 21·0 per cent. in autumn. During the whole series of twenty-five years, no rain fell in August in twenty-two cases, and none in July in twenty cases. The greatest fall in twenty-four hours was 5½ inches, in October. Snow is unknown at Beyrout, but hail occurs, on an average, on six or seven days in each year. Fog occurs very rarely; it was only observed on nineteen days during the whole period. The most prevalent wind is from the south-west, being about 31 per cent. of the whole of the wind notations; stormy days occur, on an average, only about seven times a year.

The Meteorological Office has issued its "Annual Summary" for 1905, based upon observations made at 153 stations in the United Kingdom; it contains an interesting account of the conspicuous meteorological occurrences during the year. There was a remarkable absence, after the first three months, of gales which affected any large extent of country; during the three months ending with July no general gale was experienced on our coasts. The most violent storm of the year occurred on March 15; it came on with remarkable suddenness, and at Falmouth one of the gusts reached a velocity of 103 miles. Strong gales were also experienced in the last three months of the year. Rainfall was deficient over the kingdom generally, the loss being from 10 inches to 13 inches at some places; but at several stations in Scotland and Ireland the rainfall was above the average, and at Dungeness an excess of 8 inches was recorded. There was no snowstorm worthy of special mention, although snow was of frequent occurrence in the first months of the year. Thunderstorms were recorded in every month in some part of the country, but the distribution was very irregular. The most remarkable droughts occurred in the winter season; a period of dry weather which set in about the middle of December, 1904, was maintained with but unimportant interruptions until the middle of February, 1905. May was also a very dry month over an extensive region. The maximum temperature recorded was 87°, at Maidenhead, on July 26; there were many readings of 80° and upwards. The lowest temperatures in England occurred about January 19; at Llangammarch Wells a reading of 11° was registered. In Scotland and Ireland the greatest cold was about November 19; Braemar registered 5°. Fog was prevalent in the mornings from about the middle of October; November had also several foggy days, but the worst visitation of the year occurred from December 10–14. An exceedingly high tide swept down the east coast of England on the night of January 6–7, flooding extensive tracts and causing great destruction of property; it was accompanied with a hard north-westerly gale.

An informal address by Dr. A. G. Bell to the Committee on Coinage, Weights, and Measures of the U.S. House of Representatives on February 16, giving an explanation of the reasons why the United States should abandon its heterogeneous systems of weights and measures, is printed in the *National Geographic Magazine*

for March. The committee had under consideration a Bill before Congress proposing that, from July 1, 1908, all the departments of the Government of the United States, in the transaction of business requiring the use of weight and measurement, shall employ and use the weights and measures of the metric system. Dr. Bell gave an exhaustive account of the anomalies of the British systems of measurement in use in the United States. He pointed out that all civilised countries, with the exception of the United States and Great Britain and her colonies, have adopted the simpler and more scientific decimal system. He reminded the committee that the metric system was legalised in the United States in 1866, and that its adoption by a portion of the population had increased the present confusion. By reference to the decimal system of coinage already in use in the States, Dr. Bell provided convincing instances of the simplification possible with it in the conversion of units, and explained that the United States, when it changed from the old system of pounds, shillings, and pence to the present dollars and cents, did not adopt the metric system of weights and measures because the latter, as we know it, did not appear until after the American Coinage Act of 1792. The facts that our whole system of arithmetic is decimal, that no difficulty whatever is experienced by ordinary workmen in the use of the metric system—provided there is no question of converting their measurements—and that the use of the metric system need not mean the use of new tools, were all clearly explained. It is interesting to note, in connection with this Bill before Congress, that the committee on publicity of the Metrological Society, of which Prof. Simon Newcomb is chairman, has circulated a letter urging all persons in favour of the introduction of the metric system to write, and also secure from other friends, as many letters to representatives in Congress as possible, so that they may see that public sentiment is in the direction of the adoption of decimal weights and measures.

In the Proceedings of the American Academy of Arts and Sciences, xli., 24, for February, Mr. B. O. Pierce describes, with diagrams, experiments on the manner of growth of a current in the coil of a nearly closed electromagnet, as influenced by the width of the air gap.

We have received part i. of the Transactions of the English Ceramic Society for the session 1905–6, and notice that, in view of the greatly increased activity of the society, it has become necessary to issue its publications in a serial form, instead of in a single volume at the completion of the session, as was formerly the case. The present number contains five papers read before the society during November and December of last year.

OUR ASTRONOMICAL COLUMN.

Comet 1906c.—The following extension of Dr. E. Strömgren's ephemeris for comet 1906c is taken from Circular No. 88 of the Kiel Centralstelle:—

Ephemeris 12h. Berlin M.T.

1906	α (h. m. s.)	δ (° ′)	log Δ	Brightness
April 10	3 7 6	+13 40	0·2912	0·37
14	3 15 40	+16 19	0·3084	0·31
18	3 23 54	+18 45	0·3249	0·27
22	3 31 52	+20 59	0·3405	0·23
26	3 39 38	+23 4	0·3553	0·20
30	3 47 14	+25 0	0·3693	0·17

Brightness at time of discovery = 1·0 = about mag. 8·0.

This object is now apparently leaving the constellation Aries for that of Taurus, and will pass through the Pleiades group on April 26–27.

In reference to the paragraph on comet 1905c on p. 545, where it was stated that that comet, also, would pass near to the Pleiades, the latter name was given in mistake for the Hyades.

Measurements of Linné during the Total Eclipse of the Moon.—In Circular No. 113 of the Harvard College Observatory, Prof. E. C. Pickering publishes the results of a series of measurements of the bright spot around the lunar crater Linné, made by Mr. R. H. Frost during the total eclipse of the moon which took place on February 8.

These results show that the diameter of the spot began to increase as Linné passed into the earth's shadow, and to decrease rapidly on the return of sunlight to that portion of the moon's surface.

This apparently confirms Prof. W. H. Pickering's theory that the phenomenon is due to the formation and melting of hoar-frost.

The Temperature of the Sun.—An important paper bearing on the question of the temperature of the sun's surface was communicated to the Paris Academy of Sciences by M. Henri Moissan on March 19.

In the course of his well known experiments with the electric furnace, M. Moissan recently succeeded in distilling titanium, and from the temperature therein employed he deduces probable limits for the temperature in that part of the sun's body where, as seen from the solar spectrum, titanium is volatilised.

The temperature of the arc employed has been previously determined as about 3500° C., and, taking into account the uncertainty as to the pressure existing in the solar atmosphere, M. Moissan concludes that the probable temperature varies between Prof. Wilson's estimated value of 6590° C. and the value obtained by M. Violle, viz. 2000° C. to 3000° C., the probability being that the latter value is nearer to the truth (*Comptes rendus*, No. 12).

The Melbourne Observatory.—The thirty-ninth annual report of the work done at Melbourne Observatory deals with the period April 1, 1904, to March 31, 1905, its chief point being a statement of the progress of the work in connection with the Astrographic Chart. To this end the astronomical work has been almost entirely confined to meridian observations and stellar photography.

The catalogue series now totals 1149 satisfactory plates, and is complete, whilst for the second catalogue series 455 plates have been obtained. For the chart series, with single exposures of 60m., 565 plates have been passed, thus completing this part of the work. Four hundred and ninety-five plates, with triple exposures of 30m. each, have also been obtained for the chart.

On March 31, 1905, 317 Sydney and 612 Melbourne plates, containing 177,069 and 206,604 stars respectively, had been measured.

The measurement of the long series of magnetic curves extending back for thirty-seven years was nearly completed when the report was issued, 37,212 day-curves out of about 40,000 having been measured.

Mounting the 60-inch Reflector at Harvard.—An interesting description of the method which is being employed in mounting the late Dr. Common's 60-inch reflector at Harvard College Observatory is given in No. 3, vol. xiv., of *Popular Astronomy*.

Instead of being supported on a solid pier, nearly the whole of the weight of the instrument is borne on a cylindrical steel float partly submerged in a tank of water, and so fitted as to be perfectly steady.

The coudé method of mounting has been employed, so that the observer may remain in a comfortably fitted room and make his observations through an eye-piece which retains a constant position and direction.

Electric motors have been employed to drive the telescope, and, by a number of switches conveniently placed in the observing room, the observer is able to maintain full control over all the necessary adjustments.

BIRD-LIFE AT THE SOUTH ORKNEY ISLANDS.

DURING the years 1903 and 1904 the Scottish National Antarctic Expedition made important ornithological researches in the icy regions of the far south, and also at the remarkably remote island of Diego Alvarez, otherwise Gough Island, in the South Atlantic. In both, extensive collections of birds were made, which were recently described in the pages of the *Ibis*.

The main scene of these investigations was at the South Orkneys, a group of more than a dozen islands lying some 600 miles south-east of the Falklands, and which, though discovered so long ago as 1821, had remained among the least known lands within the South Polar seas. The climate of this archipelago, in spite of its comparatively low latitude (60°–61° S.), is essentially polar, the summer temperature being much the same as in regions 10° further south, while in winter as many as 72° of frost were registered.

On Laurie Island, the second largest (30 square miles) of the group, eleven months were spent by the expedition, including the winter of 1903. During this period a number of interesting and valuable observations were made relating to the native birds (some of them little known), their habits, migrations, nidification, and geographical distribution; while the collections formed enabled me to describe phases previously quite unknown in the plumage of several rare species, and also included the eggs of forms never before obtained.

Only a few birds essayed to winter, but on the return of spring marvellous numbers arrived to spend the summer and to rear their young.

The penguins were by far the most numerous, and were of four kinds. The Adélie (*Pygoscelis adéliae*) was the most abundant, its numbers being estimated at not less than five millions; the ringed (*P. antarctica*), which was previously regarded as nowhere common, evidently has its metropolis at the South Orkneys, for at least one million nested on Laurie Island alone; while the gentoo (*P. papua*) was less numerous, since it here nears the southern limit of its range. Another species, the macaroni penguin (*Catarrhactes chrysolophus*), was found in very small numbers, but it probably breeds somewhere in the archipelago. The three first mentioned species of penguin nested in great "rookeries," some of which contained several millions of inhabitants, and extended as a broad belt for two or three miles over elevated plateaux bordering the sea. Their nests were constructed of small stones deliberately collected one by one, and, on an average, there was a nest to each square yard of the area occupied.

Life in these great bird cities was not altogether a happy one. The penguins are ill-natured and pugnacious birds, and woe betide the citizen who trespassed upon the domain of his neighbours, or the poor unfortunate who had not secured a mate and ventured within the precincts of the rookery. Then the bills of all the birds around were turned against the intruders, and a fearful commotion ensued which generally resulted in a free fight all round, each pair of birds attacking their neighbour, and ended in the rookery becoming a veritable pandemonium, rendered hideous by the harsh screeches of hundreds of thousands of voices. Such squabbles and their consequences, however, were mere trifles when compared with two scourges ever present among the sitting birds. Foremost among these were the savage giant petrels, the greatest of feathered ruffians, which wandered in numbers throughout the community gorging themselves to repletion on the eggs and young forcibly taken from the brooding penguins. The second terror was the Antarctic skua, many of which hovered overhead, like so many harpies, and incessantly swooped down to snatch the same treasures from the much persecuted parents.

When courting, as one of the pictures shows, the enamoured ones elevate their bills and utter their far from musical love songs. They do this in unison, moving their heads backwards and forwards or waving them from side to side all the while.

Next to the penguins, the petrels were the most numerous of the bird inhabitants of the island. Of these, eight species were present, most of which were nesting on the sea cliffs, or on the steep screes springing from their bases. On such sites was discovered the egg of the Cape petrel or pigeon (*Daption capensis*), a bird well known to voyagers for more than two hundred years, yet one which had hitherto succeeded in hiding its plain white egg from the gaze of oologists. Many of the eggs of this bird were found on the ledges of the cliffs, but collecting them was not a pleasant pursuit, for these birds, like some others of their order, have the power of squirting a quantity of evil-smelling oil at intruders, making good marksmanship at 8 feet. Fortunately the giant petrel (*Ossifraga gigantea*), a bird as big as a goose, did not practise this art, otherwise the taking of its egg would indeed have been an ordeal. This species, too, sat close, and when pushed off its nest, which consisted of a great heap of stones, it vomited the

FIG. 1.—Adélie Penguins' Rookery on Graptolite Island

contents of its gorged stomach, and thus lightened was able to take wing. The other species resorting to the island for a summer home and nursery were Wilson's petrel (*Oceanites oceanicus*) and the ice petrel (*Pagodroma nivea*), both of which are very abundant. A single pair of the black-bellied storm petrel (*Fregetta melanogaster*) and their egg were found, and thereby a remarkable extension southwards in the previously known range of this species established. Possibly two other petrels were nesting, namely, the Antarctic and slender-billed fulmars (*Thalassoeca antarctica* and *Priocella glacialoides*), and a whale bird (*Prion banksi*) was seen off the islands.

A tern (*Sterna hirundinacea*), a gull (*Larus dominicanus*), and a skua (*Megalestris antarctica*) nested in the vicinity of the shore, but the latter only was abundant. The blue-faced shag (*Phalacrocorax atriceps*), previously not a well known species in any respect, nested in numbers on islets off the coast; and lastly we found another little known species, namely, the white sheath-bill (*Chionis alba*), a remarkable bird distantly related to both the plovers and the gulls. It was quite common, and took up its quarters amid the nesting penguins, feeding on their dead young and broken eggs; in fact, these birds were

regular scavengers, to which the dung of seals did not come amiss.

The chief food of the millions of penguins and tens of thousands of petrels was the opossum shrimp (*Euphausia antarctica*), and when one remembers the vast numbers of this little crustacean consumed daily by the birds on Laurie Island alone, one can only compare their numbers in the sea with the grains of sand upon its beaches.

The Scottish National Antarctic Expedition is to be heartily congratulated on the excellence and importance of its ornithological work. Mr. Bruce, the leader of the expedition, has presented a complete set of the South Orkneys and other birds collected during the voyage of the *Scotia* to the Royal Scottish Museum, Edinburgh.

Fig. 2.—Ringed Penguins courting (Brown's Bay).

For the loan of the blocks from which the pictures have been reproduced we are indebted to the editors of the *Ibis*.

Wm. Eagle Clarke.

INSTITUTION OF NAVAL ARCHITECTS.

THE annual general meeting of the Institution of Naval Architects was held last week, commencing Wednesday, April 4, and being continued over the following Thursday and Friday. A full programme of twelve papers had been prepared by the secretary, Mr. R. W. Dana. The subjects dealt with were of various interest, vessels fitted with internal combustion motors occupying a good deal of attention. There was, however, no paper on the steam turbine.

On members assembling on the morning of Wednesday, the president, the Right Hon. the Earl of Glasgow, took the chair, and after the usual formal business had been transacted, proceeded to read his annual address. He referred to the launch of the large line-of-battle ship *Dreadnought*, and gave certain figures relating to the Navy Estimates. Reference was made to the proposed experimental tank at Bushy. There had been, he said, a general appeal to members of the institution for financial support, but, as the result of preliminary inquiry, it had been ascertained that a certain proportion of the amount required for building and equipping such a tank would be guaranteed by private firms and public bodies. It was obvious that the condition of shipbuilding at the time the proposals were formerly made did not favour the movement, and it was therefore decided to suspend action. Since the scheme was first mooted, additional private experimental tanks had been either laid down or projected by some of the great shipbuilding firms of the country. Such tanks as these, however, could never supply the need that existed for pure research. The council had therefore decided to call together the committee that had the matter in hand, and ascertain the views of the members on the present position of the scheme, and the prospects of its being brought to a successful conclusion. Should the shipowners of the country be unwilling to subscribe the comparatively small amount needed to build, equip, and maintain such a tank, nothing would remain but to abandon the scheme and dissolve the committee. The president hoped, however, that, before such a conclusion was reached, a fresh effort might be successfully made to carry out upon scientific lines a work of vital importance to the development of naval architecture in this country.

The first paper read was a contribution by Admiral C. C. P. FitzGerald, the subject being the new scouts recently designed for the Royal Navy. Details of these vessels were given, and the subject of naval scouting was discussed both from the strategical and tactical point of view. A discussion followed, in which several naval officers took part, and it was pointed out that the scouts were analogous to the old 36-gun frigates, these being the most powerful ships that could be detached from the fleet without weakening the line of battle.

Sir Edward J. Reed next gave an account of the vessels he had designed for service in the colonies. They were of various descriptions, consisting of both screw and paddle boats, the former being of the ordinary or of the tunnel-screw type, whilst both stern-wheel and side-wheel boats were used on the shallow waters of colonial rivers.

On the second day of the meeting the proceedings opened by Mr. R. E. Froude reading a paper on yacht measurement rules, and the late International Conference on Yacht Rating. Delegates from different countries attended this conference, but America did not send any representatives, a matter which was to be regretted. The French delegates abandoned the position they originally took up, the formula they had brought forward not being pressed. The formula ultimately agreed upon by the conference was

$$\frac{L+B+\frac{1}{2}G+3d+\frac{1}{3}\sqrt{S}-F}{2},$$

where L=length, B=beam, G chain girth, d=girth difference (*i.e.* skin girth minus chain girth), S=sail area, and F=freeboard. The reasons on which the formula was based were set forth in Mr. Froude's paper, and were also dealt with in the discussion by which it was followed.

Two papers on motor-boats followed. The first was by Mr. Linton Hope, and dealt with the speed of motor-boats and their rating for motor purposes, and the second was by Mr. James A. Smith, and was on the design and construction of high-speed motor-boats. These papers were read consecutively, and discussed together. The Marine Motor Association has adopted a formula for rating motor-boats for racing purposes. It is as follows:—

$$(P2/A)+\sqrt{L}=\text{rating},$$

where P=motor-power, A=immersed sectional area at the point of greatest beam, and L=length. Motor-power is obtained by the following formula:—

$$\frac{A\times S\times R}{C}=MP,$$

where A is the total piston area of all cylinders in square inches, S=stroke in feet, R=maximum revolutions per minute, and C is a constant equalling 1000 for 4-cycle and 600 for 2-cycle motors. Mr. Hope gave particulars of a large number of existing motor-boats, and the lines of several of the best known. The most interesting part of his paper, however, was a diagram giving curves of speeds and ratings of a large number of existing boats, the data being obtained either from racing records or trials made specially. Mr. Smith, in his paper, also referred to the methods of handicapping motor-boats by a rating rule, and gave particulars of certain of the best known recent craft of this type. A discussion followed, in the course of which Mr. Froude objected to the formula adopted because it was not homogeneous, as it included as factors both length and area.

At the evening meeting on Thursday an interesting paper was read by Mr. J. E. Thornycroft on gas engines for ship propulsion. Particulars of different types of producers were described and illustrated. A large part of the paper was taken up by a description of the Capitaine system. This consists of a suction producer and a gas engine. It had been fitted into a yacht which took part in the reliability trials at Southampton last year. It had also been fitted in a canal barge which recently made a trip from the Thames through the canal system of England to Birmingham, Manchester, and back to London by way of Oxford. These practical illustrations are considered sufficient proof that the system can be applied to marine propulsion. In the discussion which followed the reading of the paper, the chief point raised was whether bituminous coal could be used in a suction producer. Up to the present anthracite has been the fuel employed, the bituminous coal being subjected to caking in the producer, and thus stopping the working. Mr. Thornycroft stated that Mr. Capitaine was endeavouring to solve this problem, and had already constructed a producer which appeared to answer the purpose.

A paper was next read by Prof. R. S. Weighton, of Newcastle, the subject being the efficiency of surface condensers. In this paper the author described a new form of condenser which was presented to the engineering laboratory of University College, Newcastle, by Messrs. Richardson, Westgarth and Co. Very exhaustive tests had been made, there having been 400 full experiments in all. The results of these were plotted, and given in tables and diagrams accompanying the paper. The condenser is of the surface type, fitted with tubes on the general principle adopted in marine condensers. The tubes are divided into three nests, each nest being placed in a separate compartment. Water circulates through the tubes and the steam amongst them. On entering the first compartment a large part of the steam is condensed in the usual way. In place, however, of allowing the resultant water to flow over all the remaining tubes, it is trapped by means of a diaphragm, and flows at once to a receptacle at the bottom of the condenser. The steam that remains uncondensed flows into the next compartment, and circulates amongst the second nest of tubes; here a further quantity is condensed, and the water again trapped off. Any remaining steam is then condensed in the third compartment. From the voluminous tables attached to the paper it was to be gathered that for a given size of condenser and a given volume of cooling water a much larger quantity of steam could be dealt with in the form of condenser described.

On the last day of the meeting, Friday, April 6, the proceedings commenced with a paper on freeboard rules, the author being Mr. J. Foster King. The paper explained the difference between the British and the German rules in regard to freeboard, the latter allowing a deeper lading than in the case of vessels belonging to this country. For some time past the Board of Trade has been giving attention to this question, and amendments of the load-line tables have been under consideration. The President of the Board of Trade has given his sanction to amended rules and tables, such as are shown by the author in his paper, so as to bring the practice of this country more in conformity with the German rules, thus removing certain disabilities under which ships flying the British flag labour in comparison with German competitors.

A paper by Mr. J. L. Twaddell on the overhead wire cableway as applied to shipbuilding was next read. This system of transporting material on the building slip has been installed at Newcastle under the superintendence of Mr. Twaddell. It takes the place of the more elaborate overhead gantries and electric travelling cranes which have been a marked feature in some of our best equipped shipyards. In some respects the cableway is more flexible and convenient, but the durability of the cables was a point raised during the discussion which followed the reading of the paper. Experience will show how far this may prove a defect in the new system.

A paper by Mr. Alex. Murray on the introduction of cranes in shipyards dealt with a subject of a similar nature, and served to illustrate how enterprising German shipbuilders have proved themselves to be in the equipment of their yards. The cantilever cranes and tower cranes erected in one German yard, and illustrated in the paper, are of the most elaborate, and must be also of the most costly, description.

A paper by Mr. Herbert Rowell on oil-tight work in ships of light construction gave particulars of riveting and other details of strengthening surfaces necessary to make steel-plated vessels oil-tight.

The last paper read was by Mr. J. R. Barnett, and gave particulars of a number of steam yachts built within the last twenty-five years.

PHYSICAL AND CHEMICAL CHARACTERS OF HUFF.

AT a recent dinner of the Royal Society Club, Major MacMahon, who represents the Royal Society on the governing body of Winchester College, was so good as to present to the club a quantity of huff—a variety of ale for which the college has long been famous. It is brewed (from malt and hops only) in March of every other year, and is the "duplex visia" or "double beer" of Shakespeare, called "huff cap" in Greene's "Looking Glass for London and England, A.D. 1594," "because," according to the editor, "it inspirited those who drank it to set their caps in a huffing manner." The sample offered to the club was stated to have been ten years in bottle. In appearance it was clear and bright, and of a deep brown colour. Its taste was that of a well-hopped ale of high alcoholic strength.

As several members of the club expressed a desire to know something of the composition of this fine old ale, and in particular as to how it compared in character with

other beers of repute, Major MacMahon was so good as to permit an examination of it to be made in the Government Laboratory.

The results were as follows:—

Specific gravity	1·00873
Original gravity	1·11667
Percentage proof spirit	25·3
Ash—per 100 c.c.	0·465 gram.
Albumenoids—per 100 c.c.	1·001 ,,
Total acid—per 100 c.c. (as acetic) ..	0·18 ,,
Volatile acid—per 100 c.c. ,, ...	0·04 ,,
Specific rotatory power $[\alpha]_{D\,(3\cdot86)}$	+65·4

The alcohol which it yielded by distillation was further examined, with the following results, calculated to proof strength:—

	Per cent.
Esters (as ethyl acetate)	0·0524
Aldehyde	0·004
Higher alcohols	0·240

Huff is the strongest ale of which the Government Laboratory has any record. The nearest to it in point of alcoholic strength and general character is the strong Burton ale known as "Royal Ale." A sample of this, brewed in March, 1905, exported from Liverpool to New York, on analysis in the Government Laboratory gave the following numbers:—

Specific gravity	1·02275
Original gravity	1·10862
Percentage proof spirit	20·2
Ash—per 100 c.c.	0·490 gram.
Albumenoids—per 100 c.c.	0·945 ,,
Total acid—per 100 c.c. (as acetic)...	0·16 ,,
Volatile acid—per 100 c.c. ,, ...	0·036 ,,
Specific rotatory power $[\alpha]_{D\,(3\cdot86)}$	+96·0

Examination of Alcohol—Results Calculated to Proof Strength.

	Per cent.
Esters (as ethyl acetate)	0·022
Aldehyde	Nil
Higher alcohols	0·05

A number of analyses of various ales and stouts, taken from a paper by Mr. A. R. Ling in the *Brewer's Journal* for July, 1903, are appended, and for comparison the results of the examination of huff and the sample of "Royal Ale" are expressed in the same terms.

	Burton Pale Ale (Bottled)	Other Ales A	Other Ales B	Other Ales C	Strong Burton Ale	Dublin Stouts A	Dublin Stouts B	London Stouts A	London Stouts B	"Huff"	"Royal Ale"
Original gravity	1061·3	1052·8	1040·2	1059·0	1108·6	1081·4	1074·1	1072·2	1069·7	1116·67	1108·62
Attenuation gravity	1012·5	1010·4	1008·0	1013·4	1021·6	1018·2	1021·7	1022·8	1020·9	1008·73	1022·75
Absolute alcohol (by weight) ...	5·20	4·57	3·55	4·88	9·36	6·69	5·51	5·20	5·13	11·72	9·25
Total acidity expressed as acetic ...	0·10	0·08	0·07	0·08	0·16	0·20	0·20	0·16	0·14	0·18	0·16
Composition of the Extract.											
Fermented matter	64·75	64·92	64·55	62·93	66·11	63·5	58·7	55·7	56·6	76·96	65·42
Maltose (apparent)	6·05	8·04	8·32	8·74	4·19	5·1	9·6	12·1	12·2	2·38	3·30
Dextrin (apparent)	14·88	13·97	14·06	15·46	14·21	16·9	19·8	14·1	13·4	6·09	14·74
Ash	2·41	2·03	2·14	1·93	1·99	2·0	2·3	2·7	2·2	1·54	1·75
Other substances	11·91	11·04	10·93	10·94	13·50	12·5	9·6	15·4	15·6	13·03	14·79

It will be seen that the appellation of "duplex visia" as applied to huff—a liqueur among beers—is fully justified.

T. E. T.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at the college in October. The exhibition will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than October 1.

PROF. E. A. MINCHIN has resigned the Jodrell chair of zoology in University College, London, in view of his appointment to the new chair of protozoology in the University of London. Prof. E. H. Starling has been appointed to the Jodrell chair of physiology at University College. The title of emeritus professor of zoology has been conferred upon Prof. E. Ray Lankester, and that of emeritus professor of civil engineering and surveying on Prof. L. F. Vernon-Harcourt.

AMONG educational benefactions to the colleges of the United States recently announced by *Science* the following may be mentioned. By the will of Dr. W. T. Bacon his estate is given for life to Mrs. Bacon, but at her death the Hartford Medical Society will receive an endowment of 20,000*l.*, and Yale University will receive a part of the residuum of the estate, which is understood to be worth nearly 60,000*l.* It is reported that Mrs. J. B. Stetson has offered to give 20,000*l.* to Stetson University on condition that the present trustees resign. Parsons College, Fairfield, Iowa, recently received 16,000*l.* additional endowment through the will of Colonel Charles Parsons, of St. Louis. This increases the donor's gifts to 29,200*l.* Through the generosity of a Chicago physician (anonymous) and of Dr. Benjamin Taylor Terry, of New York City, Indiana University has received offers of two endowments for pathological research. The income of each fellowship is 150*l.* a year. Both offers are made under the condition that the University provides adequate library and laboratory facilities for such work.

THE Government measure to amend the law relating to education in England and Wales was introduced in the House of Commons on Monday by Mr. Birrell, Minister of Education. It is proposed that the limit of twopence as a rate for secondary education should be removed, that Wales should have a National Education Council, and that complete public control should be secured for all elementary schools receiving State aid. The first clause of the measure proposes that, after January 1, 1908, a school shall not be recognised as a public elementary school unless it is a school provided by the local education authority, so that no elementary school will receive a penny of public money, either from rates or taxes, if it does not become a provided school within the meaning of the Act. Every elementary school receiving rates and grants will thus become at once a provided school; and it will supply the same kind of religious instruction as is now given in provided schools. No catechisms or distinctive religious formularies will be taught, and the conscience clause will operate. This will be the general rule throughout the land. The second clause of the Bill authorises a local education authority, for the purpose of continuing any existing voluntary school as a provided school, to make, with the consent of the Board of Education, arrangements for carrying on a public elementary school with the owners of the schoolhouse, subject to the condition that the education authority must, during the continuance of the agreement, assume the whole responsibility of maintaining the fabric. The cost of this change is estimated at about 260,000*l.* a year. To meet the expenditure involved in these proposals, a further annual grant of 1,000,000*l.* is

to be given, in addition to the existing grants. It is proposed in another part of the Bill to make educational endowments as serviceable as possible for the advancement of education, and to consolidate, simplify, and improve the administrative machinery now in use. No provision is made for the training of teachers. We are not concerned here with the sectarian difficulties which seem to make it hopeless to contemplate a permanent settlement of the question of religious teaching in State schools. The denominationalists regard the provision of religious instruction without creed or catechism, prescribed by the Bill, as opposed to their principles and as an endowment of undenominationalism; therefore they will oppose the measure. The Labour Party, on the other hand, has taken the logical position that State aid should only be given for secular education; and that all religious instruction should be abolished in elementary schools, though moral or ethical teaching could be given based upon the best thoughts and works to be found in the literature and history of the world. Until a common factor of agreement is found in sectarian doctrines, or religious instruction is banished entirely from elementary schools, our educational system promises to continue to be the shuttlecock of opposing parties.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"On a Property which holds good for all Groupings of a Normal Distribution of Frequency for Two Variables, with Applications to the Study of Contingency-tables for the Inheritance of Unmeasured Qualities." By G. Udny **Yule**. Communicated by Prof. O. Henrici, F.R.S.

Suppose a contingency-table to have been formed for two characters which have been assigned in some way (not necessarily quantitatively) into classes. Extract from the general contingency-table the frequencies in any four adjacent compartments, and consider these as forming, by themselves, an elementary contingency-table. If the sign of association in all such elementary tetrads be the same, the general contingency-table may be termed *isotropic*. In an isotropic table the sign of the association is the same, not only for every tetrad of adjacent frequencies, but for every set of four frequencies in the compartments common to two rows and two columns. The table remains isotropic in whatever way it may be condensed by grouping together adjacent rows or columns, and if, as an extreme case, it be reduced to four-fold form, the sign of the association in such four-fold table is the same as in the elementary tetrads of the original table. If the rows and columns of an isotropic table be disarranged, the disarrangement is no longer isotropic, but the rows and columns can easily be rearranged in isotropic order. The normal frequency distribution for two variables is isotropic, and possesses the preceding properties. An examination of a number of tables recently published by Prof. Pearson for inheritance of anthropometric measurements (stature, span, forearm and head measurements) shows that all are at least approximately isotropic. On the other hand, the tables for inheritance of eye-colour published by the same writer on the basis of Mr. Galton's material, are, without exception, anisotropic, the divergence from isotropy being of such a kind as would be produced by an excess of frequency in the diagonal compartments of the table corresponding to identity of eye-colour in the two relatives. This excess, in the case of the tables for inheritance in the first degree, is not, however, so great as would be given by the theory of simple alternative inheritance, which accordingly requires modification. The same type of anisotropy appears to hold for the great majority of the tables for inheritance of coat-colour in horses given by Prof. Pearson, and also for the miscellaneous characters, mental and physical, in man, given by him in the Huxley lecture (1903). The marked prevalence of this type of distribution for such very diverse qualities, as compared—so far as investigation has gone—with its complete absence in the case of measured characters, raises the question whether it may not be, in whole or in part, of subjective origin.

The above abstract should have preceded that printed in last week's NATURE (p. 551).

January 18.—"The Growth of the Oocyte in Antedon: a Morphological Study in Cell-Metabolism." By Dr. Gilbert **Chubb**. Communicated by Prof. E. H. Starling, F.R.S.

The paper deals with the growth of the oocyte in *Antedon bifida*, Pennant, and is an attempt to utilise the morphological changes accompanying this process to determine the relative physiological significance of the various cell-structures.

The most striking expression of nucleolar activity consists in the intermittent discharge of spherules into the cytoplasm throughout the growth of the egg. Of these spherules, those discharged during the earlier period of the egg's growth constitute the yolk-nucleus, and both the origin and later behaviour of the latter structure are shown to be due to the progressively changing physical consistency of the cytoplasm. Neither the yolk-nucleus nor the nucleolar matter discharged subsequent to its formation take any part in yolk formation.

Evidence is adduced to show that the chromatin is responsible for the formation of the nucleolus, and that it is in this latter structure that the waste products of cytoplasmic activity undergo their final changes.

The irregularity of the germinal vesicle, so often accepted as an indication of the direct participation of this structure in yolk formation, is shown to be due to purely physical causes. The actual process of yolk formation is shown to be unaccompanied by increased nuclear activity, and to consist merely in the automatic conversion into a more stable form of material deposited in solution in the cytoplasm by the chromatin throughout the entire growth of the egg.

Zoological Society, March 20.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Descriptions of the species of the coleopterous genus Sciobius: Guy A. K. **Marshall**. The genus comprised forty-one species, of which twenty-two were described as new.—A contribution to the study of evolution based upon the Mexican species of Cnemidophorus: Dr. Hans **Gadow**. The main object of the paper was to trace the correlation of certain variations exhibited by the lizards of this genus, and the environmental, bionomic conditions. To do this a revision of the numerous species of the genus had been necessary, most of the ample material for which had been collected by the author himself. Especial attention had to be paid to an exhaustive study of the surprisingly great variability of certain characters, in particular the changes of the colour-pattern and the scutellation of the collar and of the limbs. The distribution of the many races, into which some of the species seemed to have recently differentiated themselves, was likewise followed up in detail.

Geological Society, March 21.—Mr. Aubrey Strahan, F.R.S., vice-president, in the chair.—The Chalk and Drift in Möen: Rev. Edwin **Hill**. The problem of Möen is to account for portions of Drift, isolated, and seemingly included, in cliffs of Chalk. It has been assumed that these portions occupy dislocations, and that the dislocations were either simultaneous with, or subsequent to, the deposition of the Drift. But cases are here described where Drift is seen to occupy cavities in dislocations, which had been water-worn, and consequently had been produced, before the advent of the Drift. A probable assumption that there were pre-Glacial cliffs similar to the present, with clefts and furrows in the cliffs, which were covered in Glacial times with a mantle of Drift now in course of removal by denudation, explains every variety of Drift-inclusion. Slopes of uniform inclination, which rise from the beach to the bases of the vertical cliffs, appear to be talus-slopes. In reality they are everywhere solid Chalk, with only a skin of débris; this suggests post-Glacial changes in sea-level.—The relations of the Chalk and Boulder-clay near Royston (Hertfordshire): Prof. T. G. **Bonney**. On the uplands south of Royston, Mr. H. B. Woodward has described three sections (Quart. Journ. Geol. Soc., vol. lix., 1903, p. 362), which in his opinion indicate that a great ice-sheet, as it advanced from the north, sheared off large masses of Chalk and mixed them up with its ground- or englacial moraine (the Chalky Boulder-clay). The author points out that this interpretation rests on an hypothesis—namely, that the latter deposit is the direct product of

land-ice—which, as it involves some serious difficulties, cannot yet be taken for granted. That ice is capable of shearing off and thrusting before it large masses of rock is also an hypothesis, for which the author, after doing his best to study ice-work in the field, can find no valid evidence. He maintains that these sections do not suggest the above explanation. At the Pinner's Cross Pit the Boulder-clay is not, strictly speaking, "banked-up" against the Chalk, but occupies a hollow in the Chalk. In the pit south-west of Newsell's Park, a shear-plane can indeed be seen in one face, which, however, is explicable by ordinary faulting. A few yards farther to the south-east, Boulder-clay appears above the floor of the pit, filling an arched cavity. This is, no doubt, a singular position, but there is nothing to show that the Chalk has been thrust over the Clay. The author suggests that, as in Möen, the Clay has been carried down from above into cavities already formed in the Chalk.—Brachiopod homœomorphy: Pygope, Antinomia, Pygites: S. S. **Buckman.** This paper deals with the diphyoid Terebratulæ, of which so many species have borne the name *Terebratula diphya* (Colonna). It is pointed out that this name is pre-Linnean, and can only date from the time when it was revived by L. von Buch in 1834. It appears that *Terebratula diphya* is not the type of the genus Pygope. Reasons are given for taking as the type of Pygope one of the forms of *T. antinomia* which is considered to be the same species as *T. deltoidea*, Val. Then the later generic name Antinomia, Catullo, is discussed. The genus was founded on five species, and one of them is now selected as the type—the genolectotype. This is *A. dilatata*, Catullo, supposed to be equivalent to *Terebratula antinomia*, Catullo, that is, to what is now selected to be the type of that species. In that case the species would bear the name *Antinomia antinomia* (Cat.). But there is yet another series of diphyoids, typified by *Terebratula diphyoides*, d'Orb. It is pointed out that, although the species covered by the name *diphyoides* are very like Pygope as now used, yet they all differ in having particular characters in the preperforate stage—a dorsal ridge and a ventral sulcus.

Royal Microscopical Society, March 21.—Rt. Hon. Sir Ford North, P.C., F.R.S., vice-president, in the chair.—A contribution to our knowledge of the Rotifera of South Africa: C. F. **Rousselet.**—A new form of finder which can be used on any microscope, and by which the object registered on one microscope can be found on any other: J. M. **Coon.**—Some Oribatidæ from Sikkim: N. D. F. **Pearce.** Most of the tropical species were on the average smaller than those found in temperate climes.—The limits of resolving power for the microscope and telescope: E. M. **Nelson.**

Entomological Society, March 21.—Mr. F. Merrifield, president, in the chair.—Six ♂♂ examples of the Pierine genus Eronia with corresponding ♀♀s: Dr. F. A. **Dixey.** Attention was directed to the extreme diversity shown by the ♀♀s in these closely allied species. Dr. Dixey considered that this characteristic was due to the fact that in every instance the ♀ had been diverted from the ordinary aspect of the group by the operation of mimicry, either Müllerian or Batesian. The species of entirely different affinities which had acted presumably as models were associated also with the exhibit.—Two specimens of *Emmelesia unifasciata* which emerged in August last from pupæ which had lain over since the autumn of 1900, thus having passed five seasons in the pupal stage: R. **Adkin.**—Progressive melanism in the Riviera of *Hastula hyerana*: Dr. T. A. **Chapman.** A discussion followed on melanism and its causes.

Physical Society, March 23.—Prof. J. Perry, F.R.S., president, in the chair.—Unilateral electric conductivity over damp surfaces: Prof. F. T. **Trouton.** Some time ago the author noticed a rather perplexing difference in electrical resistance depending on the direction in which the measuring current was passed. The resistance under examination was that of the layer of moisture which adheres to glass when exposed to moist atmospheric conditions. The arrangement in which this resistance measurement was effected was one used for determining the temperature of deposition of dew. For this purpose two parallel wires of platinum were melted on to a glass surface at a small distance apart. The surface could be artificially cooled. A cell and a galvanometer were inserted in series with the two platinum wires. As soon as moisture condensed on the glass the circuit was completed and a current passed, thus permitting the accurate determination of the dew-point. When a delicate galvanometer is used a small current can be detected long before the true dew-point is reached. It is at this stage that the anomalous behaviour in the resistance is found. On passing a current across the glass surface when exposed to ordinary atmospheric conditions, it was found to diminish to a certain minimum value, the amount of which depended on the hygrometric state. On reversal, the current assumed its original value, and then diminished to a minimum as before, and so on for further reversals. In order more conveniently to study the matter with larger currents, tinfoil grids were prepared by pasting strips of tinfoil on to glass plates. The theory put forward to account for the phenomenon depended on the transportation of moisture over the surface by the current. In this way the effective thickness of the layer might be much diminished by a banking up of the moisture along the edge of one of the metallic electrodes.—The construction and use of oscillation valves for rectifying high-frequency electric currents: Prof. J. A. **Fleming.** The author recalled the fact that so far back as 1890, when investigating the Edison effect in glow-lamps, he had shown that the space between the incandescent carbon filament and an insulated metal plate placed in the vacuous bulb possessed a unilateral conductivity, negative electricity being able to pass from the filament to the plate, but not in the opposite direction. This led him to suggest an arrangement of the above kind for separating out or rectifying the oppositely directed currents in an alternating current. This effect was now recognised as due to the copious emission of negative ions or electrons from the incandescent carbon. It was by no means obvious, however, before trial, that any such rectifying arrangement or valve would operate with currents of very high frequency. For example, electrolytic rectifiers such as the aluminium-carbon cell were not available for high-frequency currents because a time element entered into the chemical actions involved. In 1904, however, the author discovered that if the carbon filament in an electric glow-lamp was surrounded with a metal cylinder connected to an insulated terminal by a wire sealed through the bulb, and if the filament was made incandescent by an insulated battery, then between the insulated terminal and the negative pole of the battery a unilateral conductivity existed which was operative with currents of any frequency, and the valve so made might be employed to render electrical oscillations measurable by an ordinary sensitive galvanometer. The author exhibited oscillation valves made on this plan.—The use of the cymometer for the determination of resonance curves: G. B. **Dyke.** The experiments described in the paper were made with a view to the adaptation of the direct-reading cymometer to the delineation of resonance curves and the determination of the logarithmic decrements of wave trains and the resistance of oscillating sparks.

EDINBURGH.

Royal Society, February 19.—Dr R. H. Traquair, vice-president, in the chair.—The elevation of the boiling point of aqueous solutions of electrolytes: Rev. S. M. **Johnston.** The paper contained a detailed account of the method of experiment, and after giving the experimental results in a number of cases, proceeded to examine into reasons for the observed increment in the value of the elevation constant as indicated by theory. When the ratio of the molecular conductivity for a given concentration to the value for infinite dilution was plotted against the elevation constant, the graph for each salt was, up to a certain ionisation, a straight line parallel to the ionisation axis, but changed direction at this point. Arguments were adduced that this increment in the value of the elevation constant was due to hydration; and if this explanation be assumed, the observations gave a means of determining the ionisation, and therefore the concentration, at which hydration commences. Thus for solutions of CdI_2, $LiCl$, NH_4Br, and NH_4I, with concentrations respectively of 1·8, 0·92, 0·74, and 0·7 gram equivalents per litre,

it was calculated that hydration commenced at ionisations (respectively) of 0·103, 0·57, 0·678, and 0·694.—The formation of certain lakes in the Highlands: Dr. L. W. **Collet** and Dr. T. N. **Johnston**; with a note on two small lakes in the Alps. The paper and the appended note dealt with the characters of certain lakes in relation to their origin as rock basins or barrier basins.—The methods of standardising preparations of the suprarenals: Dr. Isabella **Cameron.**

March 5.—Prof. Crum Brown, vice-president, in the chair. The igneous geology of the Bathgate and Linlithgow Hills, part ii., petrography: Dr. J. D. **Falconer.** In this continuation of a former paper the petrography of the igneous rocks was discussed under three heads:—(1) the lavas; (2) the contemporaneous intrusions; (3) the later intrusions, chiefly in the form of dykes and sills, and probably of late Carboniferous age.—Three papers dealing with some of the zoological results of the Scottish National Antarctic Expedition were communicated, namely, the South Orkney Collembola: Prof. G. G. **Carpenter**; the Turbellaria collected by the expedition: Drs. J. F. **Gemmill** and R. T. **Leiper**; and the *Echinorhynchus antarcticus*: Dr. J. **Rennie.** The last paper was an account of a new species of parasitic worm obtained from the stomach of a Weddell whale.

Paris.

Academy of Sciences, April 2.—M. H. Poincaré in the chair.—Photography of the solar protuberances with coloured screens during the eclipse of August 30, 1905: H. **Deslandres** and G. **Blum.** The object of the work was to use coloured screens in order to cut off, as far as possible, all the permanent gaseous radiations of the protuberances. Three screens were used, a green screen transparent from λ 505 to λ 580, a lighter green screen transparent from λ 500 to λ 580, and a yellow screen transparent for the red, orange, and yellow. Owing to the presence of some clouds the scheme could not be carried out completely, but the general results were satisfactory, and the authors recommend the method for use in future eclipses.—The action of the radium emanation on chromogenic bacteria: Ch. **Bouchard** and M. **Balthazard.** There are two groups of chromogenic bacteria; in the first the colouring matter produced remains adhering to the bacterium, in the second the colouring matter becomes diffused throughout the culture medium. The radium emanation is not capable of modifying the chromogenic power of the first group, but exerts a distinct effect on the second group. A detailed study was made of the pyocyanic bacillus, and it was found that, amongst the various biological properties of this organism, the power of secreting pigments was the one most sensible to the action of the radium emanation. The virulence of the organism was also clearly reduced; much larger doses of the emanation were necessary to affect the reproductive power of the organism.—The heart of King Rameses II. (Sesostris): M. **Lortet.** The microscopic characters of the muscle peculiar to the cardiac muscle of the heart were clearly made out.—A new arrangement of the spectroheliograph: G. **Millochau** and M. **Stefanik.** The spectroheliographs at present in use have the disadvantage of registering on the photographic plate all the vibrations produced by the various rolling and rubbing parts used in the construction. In the instrument described an attempt has been made to reduce these effects. Remark on the preceding note: J. **Janssen.**—The analytical reduction of any system of forces in E_n: P. H. **Schoute.**—Hypertranscendental functions: Edmond **Maillet.**—The most probable numerical value of the ratio ϵ/μ_0 of the charge to the mass of the electron in the kathode rays: C. E. **Guye.** A correction is introduced into the usual formula for deducing the ratio of the charge to the mass of the electron, the effect of which is to reduce the difference between the experimental values of Simon and Kaufmann. This result is favourable to the hypothesis of the identity of the electrons which constitute the kathode rays and the β rays of radium.—The influence of compressibility on the formation of drops: H. **Ollivier.** It is shown that the formation of small liquid drops is largely influenced by the elasticity of the walls and by the compressibility of the liquid; the experimental measurements can be applied to measure the latter.—The halogen combinations of thallium: V. **Thomas.** A thermochemical paper.—The action of some alkaloids with respect to pollen tubes: Henri **Coupin.** Most alkaloids have a very toxic action on pollen tubes. Certain alkaloids, which for a given dose are toxic to the tubes, at a greater dilution may actually serve as food.—The action of carbonic acid on the latent life of some dried seeds: Paul **Becquerel.**—A contribution to the physiology of grafting: G. **Rivière** and G. **Bailhache.**—Some larval forms from the collections of the Prince of Monaco: H. **Coutière.**—The isopods of the French Antarctic Expedition: Mlle. Harriet **Richardson.**—The influence of feeding on the value of the urological coefficients and on the mean weight of the molecule elaborated: A. **Desgrez** and J. **Ayrignac.** The experiments were made on twenty-five healthy subjects, and the effects of varying diet studied. The diets included milk alone; milk, eggs, and vegetables; milk and vegetables; mixed diet, with a little meat; mixed diet, with much meat; and an absolutely vegetarian diet. The results are given in tabular form.—Demonstration of the fibrinogenic function of the liver: MM. **Doyon**, Claude **Gautier**, and Albert **Morel.**—The origin and mode of formation of Oolitic iron minerals: Stanislas **Meunier.**

DIARY OF SOCIETIES.

WEDNESDAY, April 18.

Royal Meteorological Society, at 7.30.—Some so-called Vagaries of Lightning reproduced Experimentally: A. Hands.—Note on the Value of a Projected Image of the Sun for Meteorological Study: Catherine O. Stevens.

Royal Microscopical Society, at 8.—*Exhibition*: Lantern Slides of Plant Structure prepared by Mr. A. Flatters.

CONTENTS.

THURSDAY, APRIL 19, 1906.

THE GLOSSOPTERIS FLORA.

Catalogue of the Fossil Plants of the Glossopteris Flora in the Department of Geology, British Museum (Natural History); being a Monograph of the Permo-Carboniferous Flora of India and the Southern Hemisphere. Pp. lxxiv+255. By E. A. Newell Arber. (London: The British Museum [Natural History]. Published by Order of the Trustees, 1905.) Price 12s. 6d.

IN this catalogue the author makes "an attempt towards a complete summary of what is at present known on the subject of the Glossopteris Flora," and he may be cordially congratulated on the successful completion of a task both arduous and difficult. Dr. Smith Woodward, the keeper of the department of geology, has very wisely encouraged the production of catalogues, which are in reality monographs of the greatest value to both botanical and geological students. The scattered literature dealing with the Glossopteris flora renders the work of the monographer very heavy, and the nature of much of the material on which he must base his conclusions necessitates considerable self-control and caution.

Mr. Arber's introduction treats of the Glossopteris flora under three heads:—(1) its botanical affinities; (2) its distribution in space; (3) the evidence as to its age and distribution in time. The sediments of Upper Carboniferous and Permian age have yielded a rich supply of fossil plants in both hemispheres; but in the case of India, Australia, South Africa, and South America the difficulty of drawing a satisfactory line between the Carboniferous and Permian strata has forced geologists to adopt the term Permo-Carboniferous for the plant-bearing beds of India and more southern lands. In these Permo-Carboniferous strata the genus Glossopteris is the most abundant fossil, and for this reason the southern vegetation which flourished during the epoch between the Lower Carboniferous and Triassic periods has been designated the Glossopteris flora. It has long been recognised that the Glossopteris flora differs in too many respects from the northern flora of the same geological age to justify the belief, which was formerly held, as to the world-wide distribution in the latter part of the Palæozoic era of the vegetation which is represented by the rich stores of fossils in the American and European Coal-measures. The approximate distribution of the plants of the two provinces is clearly shown in the maps published by Mr. Arber (p. xix.).

One very serious difficulty in the way of giving a satisfactory botanical account of the Glossopteris flora is the lack of petrified material, and, in the case of nearly all the genera, the absence of fertile leaves or shoots. The genus Calamites, represented by several distinct types in the northern flora, has not so far been recognised in the Glossopteris flora; in its place occur Phyllotheca and Schizoneura, two representatives of the Equisetales about which our information is still very incomplete. Both genera are adequately treated by Mr. Arber, but the botanist, however thorough the treatment, cannot help being made aware of the insufficiency of the material at his disposal. The genus Sphenophyllum affords another example of a characteristic northern type which can hardly be considered a true member of the Glossopteris flora. It is true, as Mr. Arber points out, that Prof. Zeiller has shown good reason for referring the Indian specimens, for which Royle in 1833 instituted the genus Trizygia, to Sphenophyllum. Mr. Arber figures a fragment from Natal as Sphenophyllum sp., but the specimen is too imperfect to serve as satisfactory evidence of the existence of the genus in South Africa. In the case of plants with fern-like fronds we cannot speak with any confidence as to their botanical position.

The simple tongue-shaped leaves with a distinct mid-rib and anastomosing secondary veins, which Brongniart named Glossopteris and placed among the ferns, have never been found, in spite of their extraordinary abundance, with sori or sporangia. A recent discovery by Mr. Arber affords the first satisfactory clue to the nature of the sporophylls. The fronds of Glossopteris are occasionally found in association with smaller scale-leaves, and on these groups of sporangium-like organs have been detected. These bodies are considered, on the whole, to exhibit a greater resemblance to the microspores of recent cycads than to the sporangia of ferns. The palæobotanist who describes specimens of Glossopteris is compelled to face the problem of recognising specific characters among the numerous leaf-forms, but if he knows anything of recent ferns he must admit that he has undertaken an impossible task. Mr. Arber, with the conscientious care which characterises his work, has grappled with this difficulty, and his synopsis of species supplies us with the best working scheme so far devised.

Neuropteridium is another southern genus founded on simply pinnate and sterile fronds, which, like Glossopteris and Gangamopteris, must be left as a plant of doubtful position. Among other members of the Glossopteris flora which it has been customary to place among the ferns are Tæniopteris, Sphenopteris, and Pecopteris; but the absence of fertile fronds again sets a limit to our knowledge. One interesting conclusion to be gleaned from the occurrence of certain ferns in the southern Permo-Carboniferous vegetation (*e.g.* Tæniopteris and Cladophlebis) is that the Glossopteris flora includes types which, in the northern hemisphere, are rather Mesozoic than Palæozoic.

Schizoneura, Neuropteridium, and Voltzia (a conifer) also represent other genera which apparently migrated into Europe in early Mesozoic times. Another striking fact is the absence of any members of the lycopodiales in the Glossopteris flora of Australia and India. On the other hand, Lepidodendron, Sigillaria, and some rather obscure specimens referred to Bothrodendron have been found in South Africa and South America. Mr. Arber takes the view that the occurrence of these fossils in South America and South Africa may be accounted for by

migration from the northern flora. It must, however, be borne in mind that lycopodiaceous plants existed in the far south in the Lower Carboniferous epoch.

Another characteristic member of the northern flora, which is not included in lists of plants from Gondwana Land (the name given by Suess to the southern continent which supported the Glossopteris flora), is Cordaites. It is, however, probable that the strap-like linear leaves known as Nœggerathiopsis, which are abundant in the southern Palæozoic province, are in some cases at least generically identical with Cordaites. This opinion, previously expressed by the reviewer, was strengthened by an inspection of some leaves recently discovered by Mr. Leslie which he had an opportunity of seeing last summer at Vereeniging. We have as yet no satisfactory evidence that the Cycadophyta were represented in the true Glossopteris flora. Similarly, we cannot assert with confidence that the few specimens compared by various writers with the existing *Ginkgo biloba* afford any proof of the existence of the ginkgoales. The coniferales did not play a conspicuous part in the southern vegetation; various fragments have been referred to Voltzia and other genera, but such specimens as occur appear to be indistinguishable from northern Triassic and Rhætic forms.

Although recent work has perhaps tended to bring more closely together the northern and southern Permo-Carboniferous floras, there can be no doubt as to the correctness of the view that the later Palæozoic vegetation of India, South America, South Africa, and Australia differed sufficiently from that of the northern hemisphere to justify the recognition of two botanical provinces. The southern flora lacks the richness and variety which characterise the northern; the number of genera is smaller, and in many localities the abundance of Glossopteris—almost to the exclusion of other genera—suggests a greater monotony in the vegetation. To some extent the apparently greater wealth of the northern flora may be the result of exceptionally favourable conditions for the preservation of land plants, but this does not account for the strikingly different facies. The existence of widespread Glacial deposits in India, South Africa, and Australia furnishes us with a probable means of explaining the uniformity in the vegetation of Gondwana Land and the contrast which it presents to that of the northern hemisphere. In the case of many European genera we are able to make use of anatomical characters as an index of conditions of growth, but the almost complete absence of petrified specimens in the southern province compels the admission that we cannot claim to recognise in the plants themselves any satisfactory evidence as to the nature of the climate in which they grew.

We can cordially recommend Mr. Arber's volume as the best and most comprehensive account of the Glossopteris flora which has been written; he has produced a book bearing the impress of wide knowledge and of a well balanced critical faculty, which cannot fail to be of the greatest value to both geologists and botanists.

A. C. Seward.

A GROUP OF TEXT-BOOKS OF PHYSICS.

(1) *The Organised Science Series: (1) First Stage Physiography (Section I.).* Edited by Dr. R. W. Stewart. Pp. xiii+256; diagrams. (London: University Tutorial Press, Ltd., 1905.) Price 2*s.*

(2) *Science Handbooks for Laboratory and Class-room: Elementary Physics (Third Year).* By John N. Brown. Pp. 111+diagrams. (London: Blackie and Son, Ltd., 1905.) Price 2*s.*

(3) *Examples in Physics.* By C. E. Jackson. Pp. vi+172. (London: Methuen and Co., n.d.) Price 2*s.* 6*d.*

(4) *Advanced Examples in Physics.* By A. O. Allen. Pp. 60. (London: Edward Arnold, n.d.) Price 1*s.* 6*d.*

(5) *Physics.* By Charles R. Mann and George R. Twiss. Pp. x+453; illustrated. (Chicago: Scott, Foresman and Co., 1905.) Price 1.25 dollars.

THE stream of physics text-books continues to flow. The large number of institutions in which this subject is now taught probably makes inevitable a corresponding multiplicity in the text-books issued. Each teacher or group of teachers finds something lacking in the books available for his classes, and at the first opportunity a new manual is produced. But besides the stimulus of this thoroughly healthy quest of the ideal, the requirements of examination syllabuses are important factors in giving rise to publication. Each examination has its independent syllabus somewhat arbitrarily selected from the suggestions of the members of a board, meeting in committee, and the result is that every examination is thought to require a special text-book by those who wish to secure a maximum of passes for their pupils at the least expenditure of labour.

(1) Although the latter motive is distinctly present in connection with the first of the books in our list, we must at the same time readily admit that it is a most admirable volume except in name. It is a mystery why one part of chemistry added to two parts of physics should produce "physiography," but of course Dr. Stewart is not responsible for this. The book has been written to meet the requirements of the Board of Education in regard to the examination bearing its name. Dr. Stewart is no novice in the writing of text-books. He is alive to the difficulties which pupils encounter, and he removes them in advance. The outcome is a manual which rises far above the particular purpose for which it was written, and it may be confidently recommended as a very satisfactory introduction to physics and chemistry suitable for school use. It contains a large number of examples, many of which are worked out.

(2) Mr. Brown's handbook on elementary physics forms one of a series issued under the general editorship of Dr. J. G. Kerr. It is intended as a third year's school course, practical and theoretical. The matter is to some extent of the same kind as the physical part of Dr. Stewart's text-book; we cannot, however, bestow the same praise upon it. The theoretical part is very meagre, and, moreover, in

many cases is rather crude, and with the directions for the experiments which constitute the main part we are not well satisfied. Surely in a calorimeter experiment it is not well to have the water so high as 40° C., especially when a thermometer reading to fifths is used; and surely, also, it is bad science to teach a boy that he can ascertain the temperature of a Bunsen flame by heating a 32-gram mass of copper in it and transferring it to a calorimeter. If this is done, is he too young to be shown at the same time that a small bead of copper will get visibly hotter (judging from tint), and that even a very thin platinum wire will *melt* in a Bunsen burner? The temperature found in the experiment with the copper ball is less than 1000° C. The questions at the end of each chapter are the best things in the book. Many are based on phenomena with which the boy will have acquired familiarity in his sports and other amusements, and these will certainly encourage him to take an interest also in more serious pursuits; but the problem on the hanging of a man strikes one as rather too brutal for a school-book.

(3) The volumes by Mr. Jackson and Mr. Allen consist of collections of examples. Those brought together by Mr. Jackson are of an elementary character. There are about 600 classified according to the branches of physics to which they relate, and these are followed by fifty test papers of mixed problems, each paper containing about ten questions. Thus we have here about 1000 questions the order of difficulty of which reaches practically that of the intermediate examination in the University of London. This collection will certainly be welcomed by a large number of teachers under the Board of Education and in technical schools. The advanced questions have been so constructed as to lead to reasonable results. Answers are provided only to the classified questions.

(4) The collection made by Mr. Allen is of a much more advanced character, viz., that of a final pass or honours degree in physics. The problems are selected in the main from examination papers set by the London and Victoria Universities. Answers are given, and these the present reviewer proceeded to test, but he had omitted to observe an introductory note by Prof. W. Stroud:—

"Answers are appended to the problems. This is the only feature of the book I rather regret, but they are inserted in the interests of private pupils. I should be delighted if only some of the answers were *wrong*, so that students (whose notion of working examples is to juggle with the numerics in a question so as to get the numeric in the answer) might be righteously confounded, but I have no hope; for Mr. Allen's carefulness and exactitude are such that in his preface he does not even tell the users of his book that 'any corrections to the answers will be gratefully received.'"

We commend the book as an aid to the simplification of the work of a teacher, but at the same time we hope that it will not encourage him to put altogether aside the labour of compiling his own problems based on his own experiments and study. Such examples are of far greater value both to teacher and pupil.

(5) With the aim which the writers of this volume have set before themselves we have very full sympathy. It is certain that the academic method of teaching physics tends to discourage a certain class of boy from paying any attention to his subject. To remove this fault a less formal method is desirable, especially in schools. Ultimately the youth who desires a sound knowledge must be willing to learn by logical methods, for it is by these *only* that accurate ideas can be acquired. But unless he is a born student his interest must first be aroused. He must be led to see that an intelligible account can be given of the mode of action of many of the puzzling phenomena which surround him; he must learn that things with which he has been familiar are not events isolated completely one from another so that each has no bearing on the other, but that a knowledge of one contributes to his knowledge of another. In this way a desire for further knowledge is awakened.

We have also considerable sympathy with the way in which this aim is carried out. Their book is full of illustrations, largely from half-tone blocks—motor-cars and express trains in full motion, eight-oared shells, *small* engine attached to *short* train, looping the loop, charming children swinging on a gate (so different from the ordinary wood-cut children), photographs of real ripples on a pond, engines, turbines, and other machinery, the lifting-magnet with its five-ton load of iron, mining coal with compressed-air drill these are some that meet the eye as the pages are rapidly turned over. Sometimes, indeed, the application seems rather indirect. Thus a half-tone figure of a man hard at work on the top of a hay-cart is labelled, "Haying: A man cannot work unless he consumes food." But, even in such a case, the picture is clearly intended merely to call up a series of real events, and not to portray any one with brutal accuracy. History is also called upon to contribute; knowledge has only gradually been acquired. The boy gets an idea of its growth; the "heroes" of science are introduced to him (but without portraits!).

All this is excellent, and will work well. Our only regret is that so much accuracy had to be sacrificed in the text in order to carry out the scheme completely. Is not it better, perhaps, to postpone the explanation of some things until a safe foundation for true knowledge has been obtained? The pupil will require to unlearn many of the statements made here, and this will certainly induce a period of distrust. *Some will never unlearn them.* However, the suggestion that a book of this kind might be better curtailed is the only critical one we have to offer.

MANUFACTURE OF ALUMINIUM.

The Production of Aluminium and its Industrial Use. By Adolphe Minet. Translated, with additions, by Leonard Waldo. Pp. vi+266. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 10s. 6*d*. net.

THIS book brings together the theory and practice of the aluminium industry in a complete and readable form. It commences with a more or less

detailed and historical survey of the chemical processes which were employed before the metal was produced upon a commercial scale by the aid of the electric current. The successful chemical processes which were all based upon the reduction of salts of aluminium with sodium and were simply modifications of the method used by Wöhler in 1827, when he discovered the metal, brought first and foremost in their train the remarkable cheapening in the manufacture of sodium; because unless sodium could be obtained at a low cost it was impossible to manufacture aluminium cheaply. However, by purely chemical processes it was never found possible to produce aluminium below about thirty shillings per kilo. In fact, in 1889 the price was 38*s*. per kilo., but at the end of 1891, soon after the advent of successful electrolytic processes, it had fallen to 5*s*., and at the present day it is rather less than 2*s*. per kilo.

Minet describes the electrical and electrolytic methods in chronological order. To the brothers Cowles, of America, belongs the honour of first producing a working furnace in which they were able to obtain alloys of aluminium with other metals, by striking an arc in a mixture of bauxite and oxide of iron or other metal. The Héroult seems to have been the first furnace in which a fused aluminium salt—cryolite—was actually electrolysed on a commercial scale, and modifications of this furnace are at the present day among the most successful which are employed, and the one worked by the British Aluminium Co. at Foyers is a Héroult. The production of aluminium is essentially one of electrolysis, but it is also electrothermic in so far as the passage of the current serves to keep the bath molten. The bath usually consists in the first place of fused cryolite, and as the electrolysis continues the loss of aluminium is replaced by additions of aluminium fluoride or of alumina. If the bath were regenerated by continual additions of cryolite, in time the quantity of sodium fluoride would become excessive, and sodium and not aluminium would be yielded up at the kathode.

Most authorities consider that in a bath which is regenerated with alumina the alumina and not the fluoride undergoes electrolysis. Minet, however, considers that it is the aluminium fluoride which undergoes electrolysis, and that the fluorine given up at the anode continuously reproduces cryolite.

Part ii. deals with "aluminium and its alloys." In this the author deals with the cost of the production of aluminium and its alloys. Aluminium is perhaps of more general use in the form of its alloys than in the pure condition. We see that Minet mentions its use in the pure state for surgical instruments—woe betide these instruments if antisepticised in mercuric chloride.

A few very interesting pages are devoted to the employment of aluminium as a reducing agent, in the production in the pure state of such metals as chromium, vanadium, manganese, &c., and also for welding purposes. Minet states that ingots of chromium weighing 100 kilos. are prepared at Essen in one charge, and the production of this quantity of metal is said to take only twenty-five minutes.

The translator contributes a short appendix upon "Aluminium in the United States." The book may be heartily recommended as a very useful contribution to the subject.

F. M. P.

PETROL MOTOR-CARS.

Motor-car Mechanism and Management. In three parts. Part i. The Petrol Car. By W. Poynter Adams. Pp. x + 174. (London: C. Griffin and Co., Ltd., 1906.) Price 5*s*. net.

THE author states that his object is to put into the hands of owners and drivers of motor-cars in a convenient and handy form some knowledge of the general mechanical principles which ought to be understood by those who drive them.

This idea has been carried out very fairly. The early chapters on the engine and on the various organs are treated in sufficient detail, and although there are a few blemishes and mistakes, these are not of any considerable importance.

When, however, the author deals with a matter which is extremely difficult for the average car-owner or driver to understand—namely, the understanding and care of the electrical accessories, which are now everywhere used—we can have nothing but praise for the very thorough manner in which this very difficult question has been dealt with; in fact, it is evident that the author is a trained electrical engineer, and has consequently been able to approach this subject from the standpoint of one who has had to explain the nature of electrical developments to the ordinary user of electric apparatus. We think the author's short and concise descriptions of the various sources of electrical supply which are now available, his definitions of conductors, insulators, and other electrical terms which must be used to make his explanations intelligible, are so good and so well arranged that they should be read by anyone who wishes to obtain a bird's-eye view of electrical engineering so far as it applies to ordinary users of electric light and power; at any rate, it is certain that the average user of the modern motor-car finds himself very frequently at fault when he has to puzzle out stoppages on the road due more to the failure of his electrical accessories than to any other cause, except perhaps that of the universal bugbear, the care of the pneumatic tyres.

On p. 85, when mentioning the importance of a good compression in order to get economical working of the engine, the author makes statements which are liable to mislead the user when he says that 37 per cent. of the full value of the charge is transformed into useful work, and that if the compression is increased to 100lb. this may be increased to 45 per cent. We find no note correcting this by explaining how this refers to a perfect engine, and that with such forms of internal combustion engines as are used for cars not more than 50 per cent. of such efficiencies are likely to be realised.

At the present day, when so much is being said as to the want of courtesy and consideration for other users of the road by the drivers of motor-cars, the author's remarks from p. 15 to the end ought to be read by everyone who drives a car.

OUR BOOK SHELF.

Our Stellar Universe. By Thomas Edward Heath. Pp. vi+26; with 26 star-charts and stereograms. (London: King, Sell and Olding, 1905.) Price 10s. net.

Whilst most students of astronomy are able to talk glibly of "stellar parallax" and "light-years," few of us are wont to form any persistent, concrete idea of the figures we employ, nor do the usual star-charts assist us in this matter. For this reason we extend a hearty welcome to Mr. Heath's latest effort to portray, as truthfully as the meagre data available will allow, the actual three-dimension character of space.

In his "Road Book to the Stars," which we reviewed in these columns on September 28, 1905, Mr. Heath explained how he had discovered a simple scale on which concrete comparisons of stellar depths could be based, and from that had been led to the construction of stereograms which would give a visual conception of the relative distances.

In the present volume he publishes twenty-six of these stereograms, including the whole of the sky, each one taking in fifty degrees square as seen from the earth. Twenty-six key-maps show these areas without distortion, and near each star disc are placed symbols denoting the magnitude, the spectral type, and the measured, or hypothetical, parallax. The hypothetical diameter of the star in miles, based on the assumption that the light-giving power of the star per unit area is equal to that of the sun, appears in an index, which also gives the data from which the key-maps were plotted and forms a handy and valuable reference table of the 1520 stars included.

In order to render their differences visible on the stereograms, all the parallaxes have been multiplied by 19,000, and where the actual values are unknown Mr. Heath has taken, as a theoretical quantity, the average parallax of the spectral type to which any one belongs.

Even if the stereoscopic appearance does not indicate the actual facts, these stereograms are of great interest and beauty, and should certainly find a place in every school or institution where astronomy is studied. They will, at least, counteract the natural assumption, made when ordinary star-charts, or even the sky itself, are consulted, that the heavens are simply studded with objects which are all in one plane.

For example, looking at No. 7 which shows the area facing xvh R.A. and 45° N. dec. we see η Herculis standing out in the near foreground and Arcturus far removed, whilst the Northern Crown is, at first sight, hardly recognisable owing to the unfamiliar appearance produced by the separation of its stars in the third dimension. W. E. Rolston.

Chapters on Paper-making. Vol. ii. By Clayton Beadle. Pp. vii+174. (London, 17 The Borough, London Bridge: H. H. G. Grattan, 1906.) Price 5s. net.

The object of this volume is "educational"; it is a contribution to paper-making technology, mainly as an aid to the student worker in his work of self-instruction. The author devotes himself to the task of popularising the work of the City and Guilds of London Institute by reproducing the examination papers set in the subject of paper-making in the years 1901–5, and, putting himself in the position of examinee, giving full answers to these questions.

This task is prefaced by the confession that the answers given may be in many cases open to criticism, as it is evident that certain of the subjects formulated as examination questions are in effect "leading questions" in the industry. This, however, is a tribute to the method of the institute, which, if it is to be really "educational," must keep the student mindful of difficulty, that is, of the objective realities of technical work. It is clear to us that the author has exactly appreciated the aims of the examiners in challenging the original faculties of students, and in suggesting, in the form of examination problems, some of the leading lines of progress.

In addition to this, which is the main subject-matter of the volume, the author has included a chapter dealing generally with the much controverted subjects of technical education and industrial research, and a section upon gelatine sizing embodying the results of original investigations.

The book contains a large number of special dissertations which will interest technologists and practical men, and its appeal, therefore, is to a wide circle of readers.

Anales del Museo Nacional de Buenos Aires. Ser. 3, vol. v. Pp. 574; 289 text-figures. (Buenos Aires, 1905.)

The size of this volume is a sufficient proof of the energy with which the study of biology and the related sciences is carried on in the capital of the Argentine Republic, more especially by the professors and officials of the national museum. Two papers in the present issue by Dr. F. Ameghino, the director of the museum, both dealing with the presence of a perforation in the astragalus of certain recent and extinct mammals, have been already mentioned in these columns. The bulk of the volume is, however, occupied by an article by Dr. E. L. Holmberg on the Amyrilidaceæ indigenous to and cultivated in Argentina, and a second, by Mr. F. F. Outes, on the Stone age in Patagonia. In the latter the author describes stone implements of all descriptions, from rude flint flakes and scrapers to beautifully chipped arrow-heads and perfectly spherical "bolas." The Palæolithic, or Pleistocene, implements are all referred to a single epoch. The resemblance of these implements to those found in Europe, North Africa, and North America is very close, although, as might have been expected, the closest similarity is found in the case of the North American types. In the Neolithic epoch, on the other hand, three periods are distinguishable, each indicating a distinct step in advance of its predecessor. Throughout the Neolithic epoch Patagonia presents characteristics in the matter of flint implements distinguishing it from the rest of Argentine territory. The similarity between the Patagonian neoliths and those of the southern and south-eastern United States is surprisingly close, but between the former and those of the western United States a less marked resemblance exists. Apparently some of these stone arrow-heads were used until a very recent date by certain of the Indian tribes.

R. L.

The Natural History of Selborne. By the Rev. Gilbert White, M.A. Re-arranged and classified under subjects by Charles Mosley. (London: Elliot Stock, 1905.) Price 6s. net.

The distinctive feature of this edition of the famous natural history classic is the re-arrangement of the work according to the subjects dealt with. First, there are descriptions of the locality and its physical characteristics, and these are followed by thirteen sections, respectively concerned with meteorology, geology, ethnology, mammals, birds, reptiles, fishes, insects, spiders and mites, worms, botany, superstitions, and a miscellany of subjects. This convenient arrangement will greatly assist naturalists and other students in referring to White's masterpiece.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Existence of Absolute Motion.

THE article of Prof. Schuster's in your number of March 15, entitled "A Plea for Absolute Motion," is very interesting, but I think there are several conceptions contained therein which will not bear analysis. Partly in reference to his article, therefore, but also because the question is such an important one, I think it may be well to consider as definitely as may be what direct observational or experimental evidence we have for a zero point of motion belonging to space alone, and to which all motions of material bodies may be referred.

Not to be entangled in the snare which is as old as human discussion, I define my terms for present use. By space I mean vacuum in the ordinary sense, that which exists in interplanetary space, that to which we approach in our laboratories, nothing more or less. We have good reason to believe that in the visible universe no other kind of space exists. This is not, I believe, Prof. Schuster's use of the word, but I shall try to show that it is the only proper scientific use.

By absolute motion I mean motion considered with reference to this space alone.

The first evidence is furnished by the observed orbits of binary stars. If the velocity of light is dependent on the motion of the source, light which left the star when its motion was toward the earth must of necessity reach us sooner than the light emitted when this approach component of the star's velocity was smaller or negative. The observed orbit would therefore be distorted in a perfectly definite manner. The fact that this distortion is not observed proves that the velocity of light is not dependent upon the velocity of the source, and must therefore depend upon some positional property of space alone.

The conclusion is vividly represented as follows:—Imagine a hollow sphere in space with a light source at its centre. In general, a light wave leaving the centre will not reach all parts of the surface in equal times. There exists, however, *one* motion of the sphere for which this condition is fulfilled, and this state, which is absolutely independent of all existing bodies, has a fundamental claim to be called absolute rest, because it depends on space alone.

Further evidence is furnished by the laws of electrodynamics. The magnetic effect of electric convection is generally considered to be now beyond question. From it we know that the electromagnetic attraction between two like point charges moving together is a function of their velocity. Since there is no relative motion of the two and they may be considered alone in space, the motion is with respect to space alone. The state of absolute rest is found when the electromagnetic attraction is zero for all directions of the line joining the two charges.

The evidence furnished by the Kaufmann experiment on the mass of a rapidly moving electron, indicating as it does a limiting velocity in space, also implies the existence of absolute motion.

The evidence is not so good as in the other cases, because the effect is complicated by the existence of an *outside* magnetic field with reference to which the electron moves.

I foresee Prof. Schuster's objection to the above. What I have considered he will call motion relative to the ether, while his argument was based on space in a philosophical sense. I have carefully avoided the term ether. It seems to me the word has nothing to do with the discussion. The universe, out to the furthermost visible star, is of such a nature as to be traversed by light. With space in any other sense we have nothing whatever to do, because it does not exist in the visible universe. Even if such "space" did exist outside the visible universe, it is difficult to understand how our observational data could have any bearing on the matter.

Finally, if any more argument is necessary to show that the only space we can consider is that which surrounds us in the universe, it might be derived from the fundamental notion of space perception. Our perception of space is brought about through various sensations, sensations which are caused by events which do not take place in a hypothetical space, non-existent so far as we know, but in the real space which surrounds us. Our very use of the word therefore arises out of experience, and to think of another space is to form only what Mr. Spencer would have called "a symbolic conception." Indeed, I fear if this fundamental standpoint of perception were strictly adhered to, those arguing from the standpoint of another space would have great difficulty in making themselves clear. We cannot be too careful, it seems to me, in considering the origin of our fundamental conceptions.

At any rate, real space, as has been pointed out, possesses a positional, or perhaps better a motional, attribute, and so gives us a basis, founded on experience, for a conception of absolute motion.

DANIEL COMSTOCK.

Zürich, Switzerland, April 3.

The Magnetic Inertia of a Charged Conductor in a Field of Force.

I THINK there is, in Another Place, possibly some misunderstanding concerning the inertia of a moving charged conductor due to the magnetic energy set up by its motion. It depends upon the distribution of the electrification, and may vary from a minimum up to infinity. No question of distortion due to high speed is involved, so the theory is quite simple. Say a sphere of radius a has any distribution of surface charge. For simplicity, let it be symmetrical round the axis of motion, so that the surface density is representable by the sum of any number of zonal harmonic distributions. The corresponding magnetic fields follow. Their magnetic energies are all independent, so that the actual magnetic energy is the sum of the separate magnetic energies.

The really practical case, which is also very simple, is when the conductor has a charge Q and moves in a uniform electric field F. Then the surface density is

$$\sigma = Q/4\pi a^2 + 3c F \cos\theta, \qquad (1)$$

where θ is the polar angle. The magnetic force is

$$H = H_1 + H_2 = (Qu/4\pi r^2)\sin\theta + 3cF(a^3u/r^3)\sin\theta\cos\theta. \qquad (2)$$

The magnetic energy is $\Sigma\frac{1}{2}\mu H^2$, and by integration comes to

$$T = \tfrac{1}{2}u^2[\mu Q^2/6\pi a + \tfrac{8}{5}\mu c^2F^2\pi a^3]. \qquad ($$

The magnetic inertia is therefore $m = m_1(1+h)$, where m_1 is the value for the uniform charge, or $m_1 = \mu Q^2/6\pi a$, and

$$h = n^2/15\pi, \quad \text{if } n = (3F)(4\pi a^2 c/Q). \qquad (4)$$

This n is the ratio of the induced electric force at the pole to the undisturbed force. If $n=1$, F is just large enough to make the surface density be zero at one pole. Then $h = 1/47$. This is the increased inertia due to the disturbance of the distribution of the charge. The "equation of motion" under F is

$$FQ = \{m + m_1(1+h)\}\dot{u}, \qquad (5)$$

where m is the mass of the body. The whole is subject to the restriction of small u/v and small acceleration, so that the electric and magnetic fields sensibly travel with the charge. Nor need F be constant in space or in time, provided it does not vary too rapidly in relation to the size of the conductor. In slow motion the magnetic energy is the fraction u^2/v^2 of that part of the electric energy that depends upon the transverse electric force.

April 3. OLIVER HEAVISIDE.

Old Customs and Festivals.

MY mother, now in her eightieth year, was led by a recent article by Sir Norman Lockyer in NATURE to relate some reminiscences of some of the festivals formerly celebrated in Newton-on-Ayr. One of these seems to point to ancient human sacrifices. In *her* mother's school-days, the pupils of Newton-on-Ayr annually elected a king and a queen on Candlemas Day. On "Pase Friday" (Good

Friday) the king and queen, decked with daffadowndillies, were led out to the Newton Moors, where they were solemnly interred in graves dug side by side in a sandy knowe. Hands were clasped through a hole bored in the sand between the graves.

The burial ceremony had disappeared by the time my mother went to school, but the selection of a king and queen still persisted, though in a degenerate form. The pupil who presented the largest sum of money to the teacher on Candlemas Day was crowned king or queen, and the royal health was drunk in toddy provided by the schoolmaster.

I append a list of some of the festivals in vogue in my mother's childhood. Some of them survived until within thirty years ago, but all, with the exception of New Year's Day, are now practically extinct.

Hogmanay (December 31).—Presents demanded.

New Year's Day.—First-footing; exchange of visits; carousal.

Hansel Monday (first Monday after January 1).—Exchange of presents.

Candlemas.—Election of school-king.

Huntygowk [Hunt the Gowk = Cuckoo] (April 1).—Fools' errands, &c.

May Day.—Washing of face in dew to keep freckles away.

St. John's Eve.—Firing of guns by sailors over captains' houses.

Midsummer Fair.—Great cattle-fair on main street of Newton. On this evening, or some other about this season, the herds in the neighbouring village commune of Prestwick built a great bonfire.

Kipper Fair (first Friday after August 13).—Procession of "whipmen" on gaily caparisoned horses. Horse races and gala on Newton Sands. Publication of lampoons. Feasting on kippered salmon and ale.

Hallowe'en (October 31).—The great saturnalia of the year. Stealing of kale-stocks; smashing of doors with same; smoking-out of house dwellers; disguises; turnip lanterns; diving for apples; eating from one common dish; burning nuts, and many other fortune-telling rites.

Martinmas.—Killing of the mairt or mart, the animal the carcase of which was salted down for winter use.

Christmas, Good Friday, and Easter were not observed.

I have not included hiring fairs, ordinary cattle and horse fairs, &c., or the fast days which were quite modern ecclesiastical institutions. I ought, perhaps, to have included the Queen's birthday (May 24), for, even in my boyhood, that day was honoured in such a boisterously loyal manner as compared with the non-observance of the anniversary in most Scottish towns, that I cannot help thinking the bonfire raisers may in part have inherited their enthusiasm from the traditions of some ancient festival. The progress of a blazing boat through the streets of Ayr and Newton was the crowning episode of the day. The boat was stolen from the Newton fishermen, and no combustible property was on that day safe from confiscation.

W. SEMPLE.

Dumfries, Scotland, March 1.

Chemistry in Rural Secondary Schools.

PROF. MELDOLA has raised an important question on Mr. Dunstan's letter. Speaking of two rural secondary schools, he says that chemistry (with physics) "has been taught with the greatest success" and is "of distinct value in after life." It would be useful to have information about the careers of the individual boys on which he bases his opinion, and the character of the science teaching in the two schools referred to. My experience with young farmers in Essex has led me to think that the chemistry taught in many rural schools has had too little bearing upon the problems of rural life to be of much practical use, and school life is too short to admit of a science being taught as a means of mental discipline unless at the same time the pupils are building up knowledge that is essential to future progress.

The county institution at Chelmsford to which Prof. Meldola alludes includes schools of horticulture and agriculture. Though not secondary schools, it may be useful to state that, while in teaching horticultural students the biologist found it quite possible to get on without the chemist, in teaching agricultural students the chemist could make little progress without the biologist. It was not that chemistry and physics were not taught to all the students, but that the biologist, *quâ* biologist, necessarily possessed both chemical and physical knowledge, while the chemist, *quâ* chemist, knew no biology. In rural secondary schools biology should be an important subject of instruction, most rural industries being more or less biological. But no progress in biology can be made without an adequate knowledge of chemistry and physics, so that it is not a question of whether these sciences should be taught—there can be no possible doubt about that—but how they are taught. The teacher needs to be essentially a biologist, or at any rate to have studied science in a biological atmosphere, *e.g.* in an agricultural college, in order to be able to teach chemistry as a natural science and build up a knowledge of its principles by the study of substances and phenomena that come within the experience of rural life.

To give a concrete case. A common subject of instruction in the chemistry of a rural school is Weldon's process for the recovery of manganese in the manufacture of chlorine. To not one boy in a thousand is the knowledge of this process likely to be useful in after life, unless as cram for an examination. The underlying principles could be just as well illustrated by a study of the process of liming land to neutralise acidity and promote oxidation, a better subject educationally because coming within the boy's own range of experience, and affording knowledge which might be useful to every boy in the school. But how many of the existing rural school science masters possess the knowledge of natural science necessary to deal with it?

T. S. DYMOND.

Savile Club, W., April 15.

Diurnal Periodicity of Ionisation of Gases.

IN the course of some experiments on the spontaneous ionisation of air and other gases in closed vessels, Mr. N. R. Campbell and I have detected a well marked periodicity in its value. It has two maxima and two minima in each twenty-four hours, the maxima occurring between 8 a.m. and 10 a.m. and between 10 p.m. and 1 a.m. at night, while the minima occur with great regularity at or near 2 p.m. and 4 a.m. The form of the curve drawn for the observations of any single day is, as a rule, sufficiently well marked for the maxima and minima to be apparent, while if the mean of the observations for several days be taken, the form of the resulting curve is unmistakable.

The cause of this periodicity has not, as yet, been determined. A continuous record of the temperature of the laboratory was taken, and it was found to have a simple daily period with a maximum during the day and a very regular minimum at 7 a.m. The temperature fell steadily from 6 p.m. until seven o'clock the following morning, and, as during this interval the ionisation rises to a maximum, falls to a minimum, and then rises to a maximum again, it does not seem possible to connect the variations with temperature.

On the other hand, the variations of atmospheric potential show some striking parallel features. This quantity has a double daily period. Its maxima, like those of the ionisation, are not very well defined, and occur about the same times. The minima in both cases are remarkably constant, and occur at exactly the same hours—2 p.m. and 4 a.m. The irregularities in the atmospheric potential curves are less marked during the night than during the day—an observation which holds also for the ionisation curves. Lastly, this diurnal variation of the atmospheric potential is most marked in February, and it was in the ionisation curves for February that the periodicity was first noticed.

This and other possible causes of the periodicity are at present being investigated, and although the research is necessarily a slow one, we hope soon to be in a position to publish a full account of the work.

ALEX. WOOD.

Cavendish Laboratory, Cambridge, April 9.

New Spot on Jupiter.

ON April 10 I observed Jupiter in sunshine and noted the red spot central at 5h. 43m., longitude = 30°·0. I soon remarked that the north equatorial belt curved abruptly north in the region north of the red spot and hollow, and that at the following end of this slanting attachment there was a very conspicuous dark spot which was quite new to me. It became central at 6h. 58m., longitude = 75°·3, and seemed nearly as plain as the shadow of a satellite.

On April 12 the same region of Jupiter came under review. The red spot was central at 7h. 25m., longitude = 31°·6, and the new north tropical spot at 8h. 33m., longitude = 72°·7. The shadow of the first satellite was projected on the disc at the following end of the dark material forming the south tropical disturbance, and it appeared very little darker than the north tropical spot.

Observations were made on April 10 with 10-inch With-reflector, power about 220, and on April 12 with $12\frac{1}{2}$-inch Calver-reflector, power 315.

During the present opposition of Jupiter the north equatorial and north temperate belts have been extremely faint, but the former recently developed a much deeper tone, and particularly in that section lying north of the red spot. The late outbreak of dark material in the north tropical zone will probably lead to the further intensification of the belts in this region.

It is hardly necessary to suggest that the new marking should be followed as critically and as long as possible during the short period remaining available for such observations before Jupiter's conjunction with the sun. Its rate of motion probably differs little from that of the red spot, and it may be looked for near the planet's central meridian on April 22 at 6h. 48m., April 24 at 8h. 26m., and April 29 at 7h. 37m. W. F. DENNING.

Bristol, April 14.

Oscillation of Flame Cones.

LIKE Prof. Smithells, who endeavoured to explain the phenomena described in Mr. Temple's letter to NATURE (March 29, p. 512), I have made many experiments with gas and air mixed by mechanical means and otherwise (Proc. Roy. Soc., vol. xxiv., and elsewhere), but am unable to agree with his conclusions in this case.

Assuming the mixture ascending the tube to contain 20 per cent. of gas by volume, and the relative densities of the air and gas to be as 1 to 0·5, then the *head* which produces the current is equal to a column of air 4·8 inches (0·4 foot) high, and, disregarding friction, the velocity = $\sqrt{2g\,0{\cdot}4} = 5$ feet per second.

Again, assuming the average absolute temperature of the gases above the flame, when the latter has descended to a depth of 2 feet, to be 1500° F., and the corresponding temperature of the air entering the tube from below to be 520° F., the head becomes 18 inches (1·5 foot) and the velocity = $\sqrt{2g\,1{\cdot}5} = 9{\cdot}8$ feet per second.

According to Mallard and Le Chatelier ("Annales des Mines," 8me Série, Tome iv., p. 326), the maximum velocity of translation of flame in a perfectly motionless mixture of lighting gas and air, contained in a glass tube of similar dimensions to that used by Mr. Temple, is 4 feet per second, but when the mixture is moving or agitated the velocity of translation increases, and may even assume the form of an explosive wave. The maximum velocity of 4 feet per second was obtained when the mixture contained 17·5 per cent. of gas, or, according to the authors, 2·5 per cent. more than is necessary for complete combustion.

Variations in the velocity of the current on the one hand, and of the flame on the other, appear to me to account for all the phenomena observed by Mr. Temple.

62 Park Place, Cardiff. W. GALLOWAY.

Interpretation of Meteorological Records.

IN the interesting discussion of the records of Lander and Smith's instruments at Canterbury (NATURE, March 15) both Dr. Aitken (pp. 485, 533) and Mr. Omond (p. 512) appear to have overlooked the fact that *no rain fell*, but only snow to the depth of more than 1 inch. This snow was mixed with a little hail at the commencement of the storm, but no rain fell as assumed by both your correspondents. The records state that the 0·26 inch of rainfall consisted of *snow melted as it fell*. The first sign of the storm was distant thunder and a darkening of the sky in the north-west. The glycerin barometer commenced its usual sharp rise before the first hail arrived and the storm was directly overhead. It is a curious fact that the rain or snow with a thunderstorm occurs with the sharp barometric *rise*, and not with the *fall* as one might expect. I think the great fall in temperature was due to the snow, and not as described by your correspondents. The rainfall curve did not begin first as suggested by Dr. Aitken, but the barometer as explained above. It is another curious fact that, although my house is the highest here, and has my anemometer on top of 30 feet of iron tubing above roof, and wireless telegraphy aërial 80 feet above street (with which I was busy at time of storm), yet no damage was done; but within 100 yards much lower houses had chimneys and walls thrown down and roofs split, &c., and people were seriously injured. Many houses, windmills, and a church in the district were set on fire. A. LANDER.

Canterbury.

Effect of Solar Eclipse on Fish.

DURING the partial solar eclipse observed in England on August 30, 1905, I was taking a holiday, and fishing in Slapton Ley (Devonshire). All the morning the sport had been indifferent, but as the eclipse neared its maximum the fish suddenly became ravenous, and I took more in that hour than all the rest of the day. My experience was also that of all the other boats out there at the time. The explanation, I presume, would be that the fish imagined night was approaching, and therefore prepared for supper; and as every fisherman knows, the last half-hour, when dusk is gathering, is the time that fish are mostly on the feed, and will readily take any bait.

A. MOSELY.

Union Bank Buildings, Ely Place, London, E.C., April 10.

Sea-sickness and Equilibration of the Eyes.

IN connection with the above subject (p. 511) it may perhaps interest your readers to know that German sailors recommend as a cure for sea-sickness to take a looking-glass and look steadily at your own eyes in it. Every motion of the ship is shared by the looking-glass, and consequently by so doing your own eyes follow the motion of the ship. GEOFFREY MARTIN.

Edinburgh, April 13.

AN ETHNOLOGICAL SURVEY OF THE PHILIPPINES.[1]

WITH characteristic energy, the Americans have made a good beginning with the study of the multifarious natives of the Philippine Islands. Dr. A. E. Jenks, who is chief of the Ethnological Survey for the Philippine Islands, has recently published a substantial volume of 266 pages, and 154 plates, on the Bontoc Igorot, who live in the centre of the northern end of Luzon. Judging from the short account of their physical characters, they, like so many other peoples in the East Indian Archipelago, are a mixture of Indonesians and Proto-Malays; a few are distinctly narrow-headed, about three times as many are broad-headed, and somewhat less than two-thirds are intermediate. The average stature of the men is 5 feet $4\frac{1}{2}$ inches; the women average nearly 7 inches shorter. There is no trace of Negrito blood. The

[1] "The Bontoc Igorot." By Albert Ernest Jenks. Department of the Interior. Ethnological Survey Publications, vol. i. (Manila, 1905.)
"Negritos of Zamabales" By William Allan Reed. *Ibid.*, vol. ii., part i. (Manila, 1904.)
"The Nabaloi Dialect." By Otto Scheerer. *Ibid.*, vol. ii., parts ii., iii. (Manila, 1905.)
"The Bataks of Palawan." By Edward Y. Miller. (Bureau of Public Printing.)

settlement of Bontoc is divided into thirteen wards or political divisions, called *ato*; each has its separate governing council, which can declare war or make peace. Each *ato* contains three kinds of buildings:—(1) public edifices, *fawi* and *pabafunan*, for men and

FIG. 1.—Relative Heights of American, Mixed Blood, and Pure Negrito

boys; (2) similar houses, *ola*, for girls and young women before their permanent marriage; and (3) private houses, *afong*, for families and widows. The *pabafunan* is the home of the various *ato* ceremonies, and is sacred to the male sex; it is the men's club by day and the unmarried men's dormitory; the *fawi* is the council house, and as such is frequented mainly by old men; it is also the skull-house. Dr. Jenks adds a note on the distribution of similar club-houses in Eastern Asia and in Oceania. The *olag* is the dormitory of the girls from the age of two years until they marry, and where they receive their lovers. The *afong* is the only primitive dwelling in the Philippines which is built on the ground, but it contains a small upper storey, and often an attic over this; these are used as store-rooms for cereals. The clothes, ornaments, tattooing utensils, weapons, and the like are described and figured. Of great interest are the accounts of the ordinary domestic operations, especially those connected with the cultivation of rice and the regulation of irrigation; the rules seem to be framed with common-sense, and the people appear to be sufficiently law-abiding. The hill-sides are elaborately terraced; the author doubts whether this art has been borrowed from the Chinese, and inclines to the view that it is indigenous to the East Indian Archipelago, having spread northwards to Japan. Various plants are cultivated, but rice is the most important vegetable product, and in consequence most of the religious ceremonies are in connection with this crop, and take place at stated occasions from seed-sowing to the close of the harvest. Also associated with the importance of rice in the social economy is the employment of *palay*, the unthreshed rice, as a medium of exchange, and a measure of exchange value, for articles bought and sold. *Palay* is at all times a good currency; it is always in demand, being the staple food; it keeps eight or ten years without deterioration; it is portable and infinitely divisible; it is of very stable value, and cannot be counterfeited. Certain villages have special commodities, which are made or produced in superfluity for purposes of barter, such as pots, cloths, salt, pigs. The Igorot has as clear a conception of the relative value of two things bartered as has the civilised man when he buys or sells with money; but whatever he trades, be it a five-cent block of Mayinit salt or seventy-dollar carabao (buffalo), the worth of the article is always calculated on the basis of its value in *palay*, even though the payment is in money. The standard of value of the *palay* currency is the handful—a small bunch of *palay* tied up immediately below the heads of grain; it is about 1 foot long, half head and half straw. On the whole, there is great uniformity in the size of the handful.

The forces of nature are personified in the person of the only god known to the Igorot. He instituted the club-houses and gave rules of conduct, telling people not to lie or steal, and to have but one wife; the home should be kept pure, and all men dwell as brothers.

Enough has been said to show the importance of this work, which deals in a fairly thorough manner with a people about whom nothing was previously known, and who have lived their lives uncontaminated by foreign influence. Dr. Jenks candidly admits that the time at his disposal was insufficient to exhaust the subject, and we can only hope that the work so well begun will be thoroughly completed ere long. The Igorot community seems a very favourable one for an exhaustive sociological study. It would be very desirable for an investigator to make an exhaustive census of each *ato*, recording the whole genealogies of each family, according to the method introduced by Dr. Rivers; by this means accurate information could be obtained concerning the real nature of these wards, the reason for the social and family functions of certain individuals would be made clear, and the system of kinship and the regulation of marriage would be demonstrated.

On a previous occasion we have referred to the memoir on the Negritos of Zambales, by Mr. W. A. Reed, which contains a large number of excellent plates illustrating the general appearance and some of the occupations of these very interesting and primi-

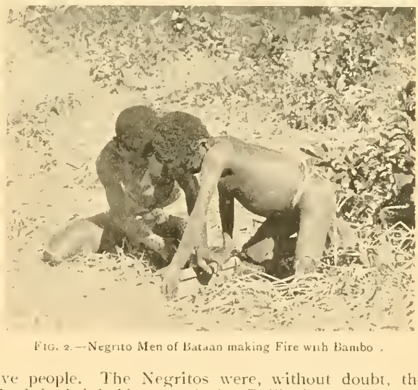


FIG. 2.—Negrito Men of Bataan making Fire with Bambo .

tive people. The Negritos were, without doubt, the aboriginal inhabitants of the Philippines, and they and their congeners in the Malay Peninsula, and in the Andamans, are the relics of one of the most archaic of human stocks. This can only be regarded

as a preliminary study, but, so far as it goes, it has considerable value and interest. The Aeta of Zambales are of a dark chocolate-brown colour, and when pure their hair is woolly; the men have an average height of 5 feet 2 inches; they are broad-headed, the cephalic index of the men averaging 82 and that of the females 86; their noses are exceedingly broad, but they have practically no prognathism. The Negritos studied by the author are not in the most primitive condition, as they have ceased to be purely nomadic hunters, and have taken to a little agriculture. It is to be hoped that Mr. Reed, or some other competent person, will pay especial attention to the real nature of the "scattered families" that wander from one place to another; to discover this it will be necessary to learn the names and relationships of every individual of each community, and this should be done

Fig. 3.—Group of Battak Women, showing Flayed-bark Skirts and Shaved Heads.

for several communities, then we shall learn whether they are clans with mother-right or families with father-right. It is important to map out the hunting grounds, and to record whether they consist of personal property.

Despite the similarity of name, there is no reason to connect the Battak of Palawan with those of Sumatra. They are a wild, hunting folk, who cultivate one or two tuberous plants, and in a few places plant small fields of rice. They gather gums, which they carry to the coast and trade for rice, beads, &c. They wear a scanty garment of bark cloth. They are a mixed Negrito people, and appear to be analogous to the Sakai of the Malay Peninsula. The present paper is only a slight sketch; doubtless these interesting people will be carefully studied in the future. They, like the Negritos of Zambales and elsewhere, are worth special investigation, as they represent the first stage of the passage from a hunting to an agricultural mode of life. No people in this stage of culture has been at all adequately studied from the sociological point of view, and our American colleagues have here a fine opportunity for investigations that are much needed by ethnologists and sociologists.

The term Igorot (the form "Igorrote" is barbarous) is one of those names like Dyak, which has been used so loosely as to be worthless; etymologically it means mountaineer, and therefore can have no racial or even tribal significance. The grammatical study by Dr. Scheerer is concerned with that division of the Igorot who know themselves as Ibaloi and their language as Nabaloi. Contrary to popular opinion, the author can trace no Chinese influence among the people, but, on the other hand, he has found among Ibaloi personal names some that are

Fig. 4.—Ibaloi Women (Girl on Right Side).

pure Japanese words. At present it is impossible to say whether these are more than accidental similarities, or to determine in which direction the loan may have taken place. Nabaloi, like all Philippine dialects, is agglutinative, built up of roots and particles; it belongs to the great Oceanic linguistic stock.

A. C. Haddon.

THE OCEANOGRAPHY OF THE PACIFIC.

A NOTABLE addition to our knowledge of the Pacific Ocean is contained in a paper by Dr. James M. Flint, published as Bulletin No. 55 of the United States National Museum. In the early part of the year 1899 the U.S.S. *Nero*, a steam collier of nearly 5000 tons, which had been purchased for use during the Spanish-American war, was fitted out and dispatched from San Francisco with instructions to survey a route for a telegraph cable between the

United States, the Philippine Islands, and Japan. The ship was in command of Commander Belknap so far as Manila, where he was relieved on account of illness by Lieut.-Commander H. M. Hodges.

As previous surveys had established a satisfactory route so far as the Sandwich Islands, the work of the *Nero* began at Honolulu, whence the ship sailed on May 6, 1899. The instructions were to follow as nearly direct lines as practicable from Honolulu to Midway Island, thence to Guam, and from Guam to Luzon; also from Guam to Japan. Soundings were to be taken on the outward voyage at intervals of 10 miles and 2 miles alternately; temperatures of the air, and surface and bottom of the sea to be recorded; currents noted; samples of bottom to be collected and preserved. The return course was planned to cross the primary route zigzag at angles of forty-five degrees, the sides of the zigzags to be 20 miles in length, and soundings to be taken at the apices. When it is stated that this plan, modified by circumstances chiefly as regards intervals between soundings and detours from the main line in order to develop marked irregularities in the contour of the ocean bed, was effectively carried out, we may agree that the belt 14 miles wide and more than 6000 miles in length has been examined with a thoroughness,

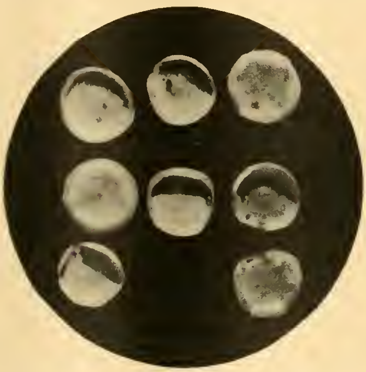


Fig. 1.—Diatom ooze obtained at a depth of 2788 fathoms in latitude 14° 24′ N., and long. 135° 31′ E. *Coscinodiscus rex*, Wallich, magnified 15 diameters.

at least in so far as soundings are concerned, which is unequalled by any survey hitherto made of an ocean tract.

The chief interest as regards depths centres about the region between Guam and Midway Islands. About half-way between the two a plain more than 3000 fathoms from the surface is interrupted by what is apparently a range of mountains, extending over three degrees of longitude, and rising in places to 720 fathoms from the surface. From the western limit of the plain, some 300 miles from this mountain range, the contour is quite irregular until Guam is reached. Extensive detours to north and south of the direct course showed a mountainous region, with peaks rising to 689 fathoms below sea-level and valleys descending to a depth of more than 5000 fathoms. Four soundings below the 5000-fathom line were made in an abyss to which the name "Nero Deep" was given, with the record of 5070, 5101, 5160, and 5269 fathoms. The last sounding is, of course, the deepest on record, being only 66 feet less than 6 statute miles. Its position was lat. 12° 43′ 15″ N., long. 145° 49′ E., or 75 miles E.S.E. of the island of Guam.

From Guam to Yokohama the soundings indicated a continuous range of mountains connecting the Ladrone Islands with the Bonin group.

Another result of importance obtained by the *Nero* is the discovery of diatom ooze as a bottom deposit in tropical waters. Many distinct patches of characteristic diatom ooze were found on the line, especially between Guam and Luzon. Along a line about 300 miles in length, lat. 14° 28′ to 14° 50′ N., and long. 136° to 130° 30′ E., diatom ooze was brought up at thirteen stations from depths between 2432 and 3547 fathoms. Again, between Guam and Midway Islands ooze of a similar kind was obtained at three stations. In all the specimens examined the diatoms belong almost exclusively to a single species, identified by Prof. Mann as *Coscinodiscus rex*, Wallich. We reproduce the figure given in the plates accompanying the paper of "diatom ooze from station 746 (lat. 14° 24′ N., long. 135° 31′ E.), 2788 fathoms. Magnified 15 diameters."

We are unable to do more than direct attention to the two most remarkable discoveries made by this expedition. It is scarcely necessary to add that the table of 2074 soundings, with details of bottom deposits, and a large number of temperature observations, forms in itself an even more valuable contribution to oceanography than the two "records" we have mentioned.

AGRICULTURAL RESEARCH IN INDIA.[1]

THE publication of the first annual report of the Imperial Department of Agriculture of India is little short of an epoch-marking event. As I have said elsewhere, agricultural research has not been wholly neglected in India in the past. Much excellent work has been done by able men working under conditions which were never encouraging. But it has been fitful and uncoordinated, and always at the mercy of uninstructed and unsympathetic officials, whose one canon of criticism has been the solvency of the annual balance-sheet.

India now possesses what it may be hoped before the century has run out will be regarded as the Rothamsted of the East; and the characteristic irony, I might almost say cynicism, of the British race is content that it should owe its foundation in great part to the large-minded munificence of an American gentleman.

The outcome will not be found to-day or to-morrow, but only after years of patient work. The Government of India must not be impatient for immediate results or querulous about current expenditure. That must needs be capital invested, and the return will be the eventual increase of the wealth and prosperity of the population of India.

It now possesses for the first time a real agricultural "headquarters staff." The various experts charged with particular features of the biological campaign are no longer scattered, but are brought together in one institution, where they can work in sympathetic partnership. A glance through the pages of this report is sufficient to reveal the enormous area of the field before them. It may be prudent at the start to make a sustained attack on a few problems rather than to nibble at many.

W. T. Thiselton-Dyer.

[1] Annual Report of the Imperial Department of Agriculture for the year 1904–05. (Calcutta: Government Central Press, 1906.) Price 1*s.* 2*d.*

THE ERUPTION OF VESUVIUS.

THE eruption of Vesuvius has quieted down since last week, though scoriæ and ash continue to be ejected and there still seems to be a slow flow of lava, but in comparison with the activity of the eruption on April 8 the volcano is quiet—until next time. How soon or how long deferred this may be cannot be predicted, but the pause has enabled us to take stock of events and form some estimate of this outburst as compared with previous ones. The most important qualification of earlier reports is in regard to the reported flow of lava through the streets of Ottajano; an outburst of lava on the outer slope of Monte Somma would be remarkable indeed, but later accounts show that none such took place, the damage at Ottajano and San Giuseppe being due to a very heavy fall of ash.

The reports from the Vesuvian Observatory and the definite statement of Messrs. Thos. Cook and Son that their electric tramway has not suffered more than a temporary interruption of traffic, due to the fall of ash, show that no lava flowed in that direction. On the other hand, there seems to have been an extensive outflow into the Atrio del Cavallo and on the south side of the volcano. The lava, which stopped just short of Bosco-Trecase, seems to have reached further than the stream of 1754.

In spite of the prominence given to these lava streams in the daily papers, the eruption seems to have been less remarkable, in this respect, than that of 1895, not to mention others of earlier date, but the volume of volcanic ash produced and scattered over the surrounding country has been very great, and the aspect of the volcano has been materially changed, not only by the addition of a mantle of grey ashes, but also by the destruction of a portion of the cone. The upper part of the funicular railway has been destroyed—blown away, so far as can be made out—in the enlargement of the old crater; the volcano as a whole is noticeably lower than it was, and must have resumed very much the aspect it showed after the eruption of 1822.

The Naples correspondent of the *Times* described in Tuesday's issue the nature and results of the recent eruption. Some extracts from this narrative, dealing with points of scientific interest, are subjoined, with a diary of events abstracted from Press reports.

The most intense activity occurred on the night of Saturday, April 7, when the sides of the cone subsided and the streams of lava, already set free, gained a terrible impulse. The electric phenomena of thunder and lightning, which ordinarily attend any great volcanic convulsion, were then at their height, and the ejection of large blocks from the crater and fiery scoriæ is said to have surpassed anything within the memory of the present generation. The main courses taken by the lava flow seem to have been six in number: towards Ottajano on the north, to San Giuseppe and Terzigno on the east, past Bosco-Trecase to Torre Annunziata on the south, to Torre del Greco and past the observatory on the west. Of these, the most formidable stream was that which descended towards Torre Annunziata, those which deviated towards Torre del Greco and Terzigno being only its branches. At Torre Annunziata the lava stopped just short of the wall of the cemetery outside the town.

The actual area of ground covered by lava cannot yet be conjectured, though it is believed to exceed that covered by all recent eruptions. Next in importance comes the fall of volcanic dust and scoriæ. The direction of this fall varied each day. The worst suffering was inflicted upon Ottajano and San Giuseppe Vesuviano towards the north-east. In both places a large number of houses succumbed to the weight that fell on their roofs. Considerable damage was also done, from the same cause, at Torre del Greco.

During the first three or four days the dust plunged the towns in the immediate vicinity of the volcano into utter darkness, and materially increased the panic that had already set in. Even Naples was in a state of semi-darkness, from which it had hardly emerged on April 12. The roofs and roads seem to be inches deep in an extraordinarily fine, reddish-grey dust, which rises in dense clouds behind every carriage and foot passenger.

In some places the drift of ash seems fully a yard deep; at Ottajano and San Giuseppe in the lightest deposits it must measure three inches. The great danger in both places and, indeed, in most of the towns on the slopes of Vesuvius—would be a heavy rainfall and the formation of mud-torrents, which will more than complete the ruin already begun by the lapilli. At the coast towns, Torre del Greco, Torre Annunziata, Resina, and others, the work of disencumbering the streets and buildings of the lapilli and ashes is already in active progress.

It is difficult to compare the extent of this latest eruption with that of those which have preceded it. Eyewitnesses of both declare it to have been more formidable than that of 1872, which practically destroyed Torre del Greco for the fourth time. The distance to which the ash was carried is so dependent on other atmospheric influences that it cannot constitute a test. In this case the ash seems to have reached Bari and towns on the Adriatic coast. One notable change has been wrought by the eruption. The cone, which has for so long been such a distinctive feature of the mountain, appears to be gone.

The following diary of the eruption is in continuation of that given last week:

April 11. *Vesuvius Observatory.*—Report from Dr. Matteucci: "For brevity's sake I do not give details of my position and that of the carabineers at the observatory, which has been very unpleasant and alarming. Throughout the night and up to 8 o'clock this morning we were completely enveloped in dense showers of dust. As I telegraph everything tends to reduce anxiety, and the seismic instruments show quieter records than yesterday. I shall remain here as long as possible—as long as I have food. If my words could influence the popolation they would be words of encouragement and sympathy in full confidence that Vesuvius will shortly become calmer."

Showers of volcanic ash and other fragmentary products continue to fall. San Giuseppe almost buried in places by mounds of ash and lapilli, and Ottajano in much the same condition. Torre Annunziata remains abandoned, and Torre del Greco is almost deserted. The roads in Naples are covered with a thick layer of volcanic dust, which continues to fall upon the city. The summit of the volcano cannot be seen on account of the dense clouds of steam and dust over it, but it is reported that the shape of the cone has undergone great change, and Dr. Matteucci estimates that the top is now nearly 250 metres lower than before the eruption.

April 12. Seismographs quiet. Volcanic ash has ceased to fall in Naples, Portici, Torre del Greco, and Torre Annunziata, but the shower continues at Ponticelle, St. Anastasia, and Somma.

April 13. No noticeable disturbances. The volcano still surmounted with a dense cloud, which appeared, however, to be disappearing.

April 14.—A shower of ash fell at San Giuseppe Vesuviano and Ottajano to a depth of about 1½ inches. Heavy falls of dust also recorded in the communes of Collina, Strocchia, Boscoreale, Somma, and Ottajano. Slight earthquake shock felt at Ottajano and Terzigno.

April 15.—At 2 p.m. a heavy shower of ash began falling at Ottajano, Boscoreale, Bosco-Trecase, and Torre del Greco, causing intense darkness. There was a slight fall of ashes at Portici, Resina, San Sebastiano, and San Georgio.

April 16. No signs of activity. Seismographs quiet.

April 17.—Conditions normal except for a shower of ash falling on Ottajano and St. Anastasia. Dr. Matteucci reports from the observatory that, with the exception of a few hours, last night was calm. The activity of Vesuvius is limited to a decreased emission of dust, falling in the eastern districts.

NOTES.

We regret to announce that Prof. W. F. R. Weldon, F.R.S., Linacre professor of comparative anatomy, Oxford, died suddenly on Friday last, April 13, at the early age of forty-five.

The University of Berlin has announced the award of a prize of 50*l.* for the best physical or mathematical research presented to the philosophical faculty for the doctor's degree in 1906.

The eighty-ninth annual meeting of the Swiss Scientific Society will be held this year at St. Gall from July 29 to August 1 under the presidency of Dr. Ambühl. The programme will include an excursion to Mt. Sentis.

On behalf of the family of the late Prof. Manuelli, of Modena, Herr T. Waitzfelder has presented the Munich Museum with an interesting collection, in which are some original pieces of apparatus used by Galvani and other Italian investigators, together with some pieces of alchemistic apparatus.

The Schleswig-Holstein Board of Agriculture has elected Dr. Hans Wehnert to succeed Prof. Adolf Emmerling as director of the agricultural chemistry laboratory at Kiel. Dr. Wehnert studied at Brunswick Technical High School and Rostock University, and has had a wide experience as a manufacturer's chemist.

Mr. Edgar R. Waite has resigned his position as zoologist, Australian Museum, Sydney, consequent upon his appointment to the curatorship of the Canterbury Museum, Christchurch, New Zealand. Before he left England for Sydney in 1892 Mr. Waite was an active secretary of the Yorkshire Naturalists' Union, and also editor of the *Naturalist*.

A correspondent of the *Daily Mail*, at Entebbe (Uganda), reports on April 10 that Lieut. Forbes Tulloch, who accompanied the Royal Society's commission sent there to investigate sleeping sickness, has accidentally contracted the disease, and has left for England in charge of Lieut. Gray. The message states that the commission's laboratory has been closed, and all the inoculated monkeys shot to avert further accidents.

A message from a correspondent of the *Times* in Athens states that a telegram from Sparta announces the discovery of the famous sanctuary of Artemis Orthia, before whose altar the Spartan youths were scourged when initiated into the privileges of manhood. The site is on the bank of the Eurotas. Votive offerings of ivory and terra-cotta and quantities of small leaden figures have also been found, as well as pottery, which confirms the belief that this was one of the most ancient Spartan shrines.

The council of the Institution of Naval Architects has nominated Mr. Sidney W. Barnaby to represent that institution on the sectional committee on screw threads and limit gauges of the Engineering Standards Committee in the place of Mr. McFarlane Gray, resigned. The Secretary of State for India has nominated Mr. A. Brereton to represent the India Office on the sectional committee on locomotives in the place of Sir Frederick R. Upcott.

On Thursday next, April 26, Dr. P. Chalmers Mitchell will deliver the first of two lectures at the Royal Institution on "The Digestive Tract in Birds and Mammals." The Friday evening discourses will be resumed on April 27, when Prof. J. W. Gregory will deliver a discourse on "Ore Deposits and their Distribution in Depth." The discourse on May 4 will be given by the Hon. C. A. Parsons, on "The Steam Turbine on Land and at Sea," and on May 11 by Prof. J. H. Poynting, on "Some Astronomical Consequences of the Pressure of Light."

Hermann Schnaus, one of the most thorough and earnest German writers on photography, died on March 14 from paralysis. Beginning life as a bookseller's assistant, first in Jena and afterwards in Bonn, Frankfurt, and Zürich, Schnaus in 1881 entered the photographic publishing firm of Liesegang, at Dusseldorf. After editing *Photographische Archivs*, the first German periodical devoted to photography, Schnaus founded first *Der Amateur-photograph* (now *Photographische Welt*) and afterwards *Appollo*, and in 1905 took over the editorship of the *Photographische Industrie*, to the pages of which he had assiduously contributed from its inception.

From the *Chemiker Zeitung* we learn that the Syndicate of French Sugar Manufacturers, 42 rue du Louvre, Paris, is offering for competition a prize of 100,000 francs for a new application of sugar in the industries, other than the food industry. A condition of the award is that the suggestion shall have been tried in France, and, according to official statistics, have caused an increase in the consumption of sugar in France of at least 100,000 tons in the year. The support of the syndicate is promised in the event of a diminution or the complete abolition of the present sugar tax being necessary for the successful development of the proposed application. Foreigners are not prevented from taking part in the competition.

On March 17, at Baden-Baden, Prof. Adolf Emmerling, director of the agricultural chemistry laboratory of the Board of Agriculture of the province of Schleswig-Holstein, died in his sixty-fourth year. After graduating at Freiburg in 1865, Prof. Emmerling was for nearly four years an assistant in the chemical laboratory of Freiburg University, and for a further two years under Bunsen at Heidelberg; from thence he went to Kiel to direct the work of what was then the agricultural chemistry laboratory of the agricultural Gewerbeverein, which position he held until his death. His numerous scientific researches were published mainly in the *Berichte* of the German Chemical Society and the "Landwirtschaftlichen-Versuchsstationen"; these included a number of new experimental methods and descriptions of new apparatus. Prof. Emmerling, who was a Knight of the Order of the Red Eagle, received the title of professor in 1882, and that of Geheimer Regierungsrat in 1900.

Sir Thomas Browne, the author of "Religio Medici," who lived at Norwich in the middle of the seventeenth century, was buried in the church of St. Peter Mancroft during the early part of the last century. It is believed that his skull was abstracted from the grave and is now preserved at the Norfolk and Norwich Hospital. We learn from the *Times* that recently there has been a considerable expression of opinion in Norwich that the skull ought to be returned to the tomb whence it was taken. The hospital governors on Saturday unanimously passed a resolution agreeing to this course, on condition that the tomb shall be opened in the presence of representatives of the hospital with the view of satisfying them that the remains therein are without a skull.

An earthquake as severe as that of March 17 occurred in South Formosa in the morning of April 14. Kagi was again the town which suffered the most damage. By the disturbance on March 17 1228 persons were killed and

2329 injured, while 5556 houses were totally, and 3383 partially, destroyed. In the present case seven persons were killed and thirty-five injured at Daigo, where 400 buildings were destroyed, while in the Ajensui district the casualties amounted to three killed and fifteen injured, 1191 houses collapsing and 749 being partially wrecked. A Reuter message states that the shock of April 14 was much more severe than that of March 17, and the low death roll, as well as the comparatively small amount of damage done, is to be explained by the fact that the people were more on the alert after their experiences of last month, and that after the havoc caused by the first disturbance there was not much left to destroy.

ARRANGEMENTS have been made to hold a joint meeting of members of the American Institute of Mining Engineers and of the Iron and Steel Institute in London during the week commencing July 23. The Lord Mayor of London has kindly consented to act as chairman of the London reception committee, and a varied programme of entertainments, visits, and excursions will be provided. Meetings for the reading and discussion of papers will be held on the mornings of July 24, 25, and 26, with visits to works in the afternoons. The Lord Mayor will give an evening reception at the Mansion House on July 24. On July 27 the annual dinner of the institute, to which the American visitors are invited, will be held at the Guildhall. Detailed particulars will be issued when the arrangements are further matured. After the meeting in London, a tour will be arranged for the American visitors to York, Middlesbrough, Newcastle-on-Tyne, Glasgow, and Edinburgh. As an alternative excursion a number of the American visitors have been invited by the local reception committee for the summer meeting of the Institution of Mechanical Engineers to take part in the Cardiff meeting of that society.

As previously announced, the annual meeting of the Iron and Steel Institute will be held on May 10–11. At the first meeting the Bessemer gold medal for 1906 will be presented to Mr. Floris Osmond (Paris), and the awards of the Andrew Carnegie gold medal and research scholarships for 1906 will be announced. Among the papers that are expected to be submitted during the meeting are the following:—Influence of silicon, phosphorus, manganese, and aluminium on chill in cast iron, E. Adamson; influence of manganese on iron, Prof. J. O. Arnold; relation between type of fracture and microstructure of steel test pieces, C. O. Bannister; use of oxygen in removing blast furnace obstructions, C. de Schwarz; volume and temperature changes occurring during the cooling of cast iron, Prof. T. Turner. The following reports on work carried out during the past year by holders of Carnegie research scholarships will be submitted:—Hardness of the constituents of iron and steel, Dr. H. C. Boynton; heat treatment of wire, J. Dixon Brunton; quaternary steels, Dr. L. Guillet; influence of carbon on cast iron, W. H. Hatfield; preparation of carbon-free ferromanganese, E. G. Ll. Roberts and E. A. Wraight; deformation and fracture in iron and steel, W. Rosenhain.

THE most important paper in No. 181 of the Proceedings of the American Philosophical Society is one by Miss M. E. Marshall on the anatomy of that aberrant nightjar *Phalacnoptilus nuttali*, the investigation taking into consideration the mutual relationships of the three families usually included in the Caprimulgi.

AMONG the contents of the *Sitzungsberichte* of the Royal Bohemian Academy of Sciences for 1905 may be mentioned an article by Dr. A. Frič on the reptiles of the Bohemian Cretaceous; Montenegro leeches, by Mr. R. Blanchard; the glands of holothurians, by Mr. K. Thon; and the third part of an account of certain fresh-water amphipod crustaceans, by Prof. F. Vejdovský.

IN a paper published in the Proceedings of the Rochester (U.S.A.) Academy of Science (iv., p. 203) Mr. C. L. Sarle concludes that the Silurian fossils described as Arthrophycus and Dædalus, the nature of which has received very various interpretations, are really burrows, Dædalus, at any rate, being probably the work of a sedentary polychætous annelid. The structures form elaborate open spirals of the "Archimedean" type.

THE concluding portion of the catalogue of the marine shells of Victoria, by Messrs. Pritchard and Gatcliff, forms the main portion of the contents of part ii. of vol. xviii. of the Proceedings of the Royal Society of Victoria. Mr. F. Chapman describes a new cephalaspid fish from the Silurian of the colony, referred to the genus Thyestes (Auchenaspis), as *T. magnificus*. The species of the genus hitherto known are all small, but the new one rivals in this respect the majority of the representatives of the typical Cephalaspis.

THE contents of Scientific Investigations (Fisheries, Ireland), No. 7, 1904 (1906), include a report by Mr. E. W. L. Holt on artificial propagation of Salmonidæ in 1904–5; notes on the spawning season of rainbow trout, by Mr. C. Arens (the translation of a paper written for the International Fish Congress at Vienna last year); records of salmon-marking experiments in Ireland from 1902 to 1905, by Mr. A. B. E. Hillas; and statistical information relating to salmon fisheries.

IN a report by Mr. E. D. Sanderson on miscellaneous cotton-insects in Texas, forming Bulletin No. 57 of the Entomological Division of the U.S. Department of Agriculture, attention is directed to the fact that, owing to the ravages of the "boll-weevil," cotton cultivation has entered on a new phase in Texas, and that noxious insects which were formerly ignored have now assumed, in consequence of early and rapid cultivation and reduced acreage, increased importance as factors in the success or otherwise of the crops. Although the investigation is still in its infancy, it is suggested that the remedy for these minor pests will be found in improved methods of cultivation rather than in recourse to poisons.

WE have received separate copies of several papers recently published in the *American Journal of Science*, among which are three by Mr. G. R. Wieland on Cretaceous turtles and tortoises, which have been already noticed in our columns. In a fourth the same author discusses the "pro-embryos" of the fossil cycads of the group Bennettiteæ. Since, with the exception of the archegonia of Cycadinocarpus, no developmental stage has hitherto been described in any fossil plant, the discovery is regarded by the author as one of the highest importance. This paper is dated 1904; while others, by Dr. J. Wortman, on remains of Eocene Primates in the Peabody Museum, were originally published during that and the preceding year. Of more recent date is a revision of the New York Helderbergian crinoids, by Miss M. Talbot, and a review of the fauna of the Palæozoic Chazy Limestone of North America, by Mr. P. E. Raymond.

NOTES on Bahama snakes, by Mr. J. L. Cole, and the description of a new Bahama sea-spider, or pycnogonid, by Mr. T. Barbour, form two of the articles in the March issue of the *American Naturalist*. Mr. W. Stone con-

tributes notes on Pennsylvanian and other reptiles and amphibians, while Prof. M. A. Wilcox commences an account of the anatomy of the limpet, *Acmaea testudinalis*, a subject to which he has for several years devoted attention. The author states that he has endeavoured to make the communication "serve as an introduction to the study of the fascinating but neglected group of Gastropoda." In the sixth article Dr. A. Hollick and Prof. E. C. Jeffrey discuss the affinities of certain Cretaceous plant remains commonly assigned to the genera Dammara and Brachyphyllum. The so-called Dammara is assigned to a new genus of araucarian under the name of Protodammara, while the shoots and branches referred to Brachyphyllum are likewise of an araucarian nature.

The February number of *Le Bambou* contains an article on the identification of species of Phyllostachys, also cultural hints on some of the Arundinarieæ, and notes on the resistance of bamboos to frost in the south of France.

The list of new garden plants for the year 1905, issued as appendix iii., 1906, to the Kew Bulletin, contains, as usual, a large number of orchids, especially species of Cattleya, Cypripedium, Dendrobium, and Odontoglossum. The African continent continues to furnish a considerable proportion of plants, including species of Aloe, Lissochilus, and Polystachya. Messrs. J. Veitch and Sons have introduced a number of Chinese plants, of which the Primulas have attracted attention, particularly *Primula Cockburniana* that bears large orange-scarlet flowers.

A second paper on the Panama Canal, by the Hon. Theodore P. Shonts, chairman of the Isthmian Canal Commission, is published in the February number of the *National Geographic Magazine*. The experiments with foreign labour, arrangements for transportation facilities, and similar matters are fully described.

The report on the state of the ice in the Arctic seas during 1905 has been issued by the Danish Meteorological Institute. The general conclusion drawn is that great masses of ice were disengaged from the firm ice in the north polar regions at an earlier date than usual, and the ice drifted southward faster and in greater quantities than in a normal year.

The February number of the Bulletin of the American Geographical Society is almost entirely devoted to a report of the second annual meeting of the Association of American Geographers, which was held in New York on December 26 and 27 last, under the presidency of Prof. W. M. Davis. About thirty-three papers were communicated, and abstracts of most of these are to be found in the report.

In an article entitled "Winning the West," in the February *National Geographic Magazine*, Mr. C. J. Blanchard gives an interesting account of the extraordinary progress made by the United States Reclamation Service during the last few years. Of the fifty millions of acres which it is estimated can be reclaimed from the desert by irrigation, ten millions have already been made productive, at a cost of some ninety millions of dollars. This area is occupied by a population of about two millions, and every year it returns a harvest valued at more than one hundred and fifty millions of dollars.

We have received a reprint of a paper, published in the Bulletin of the American Geographical Society, by Mr. Daniel T. Macdougal, on the delta of the Rio Colorado. With the help of a map by Mr. Godfrey Sykes, which accompanies the paper, the author describes the complex hydrography of the region between the international boundary and the present head of the Gulf of California. Some useful notes on the climate and flora are added. The paper gains in interest from the fact that the Salton sink and Imperial Valley immediately to the north of the boundary are likely to be greatly modified in the near future by the work of the U.S. Reclamation Service.

The report of the Meteorological Council for 1904–5 (the last year of the administration of the Meteorological Office by that body), which was recently presented to Parliament, contains an interesting account of the operations of the office since its establishment as a department of the Board of Trade under Admiral (then Captain) FitzRoy in 1854. The amount of up-hill work carried out by Admiral FitzRoy, with Mr. T. H. Babington as scientific assistant, and the very few clerks at his disposal was remarkable. His first care was to issue trustworthy instruments to vessels of the navy and mercantile marine, and to collect observations relating to meteorology over the oceans; but pending the receipt and collation of these observations he quickly converted Maury's numerical wind charts into seasonal charts of graphical wind-stars, and issued them in great numbers to seamen. These were soon supplemented by monthly charts, from observations obtained from British ships, combined with those from Maury's charts. Subsequently he collected and collated synchronous observations for both land and sea, from the study of which he was enabled to commence his system of storm signals and weather forecasts by which his name in this country is best known. After his death, in 1865, the management of the office was placed under a committee of the Royal Society, with an increased grant; this body established the self-recording observatories, and under the able administration of Mr. R. H. Scott, as director, the operations of the office were greatly extended. In 1877, on the recommendation of a committee of inquiry, the Meteorological Committee, the services of the members of which were honorary, was replaced by a paid council, with a further increase in the grant. After the lamented death of Prof. Henry Smith in 1883, General (now Sir Richard) Strachey became chairman; his great administrative power and ability in the direction of the constantly increasing work and usefulness of the office (with Mr. Scott, and more recently Mr. Shaw, as secretary), are too well known to require further comment here. The work of all departments, relating to marine meteorology, weather forecasts, and the discussion of the observatory and other records, attained a high degree of excellence, and compares favourably with that performed by any foreign meteorological organisation.

A new method of exactly standardising thermometers between 0° C. and $-4°.0$ C. has been devised by Prof. T. W. Richards and Mr. F. G. Jackson; it is described in the Proceedings of the American Academy (vol. xli., No. 21), and consists in observing the temperatures recorded for the freezing point of dilute hydrochloric acid solutions of known concentration. A table is given of the values for the freezing point of solutions of different strengths. The method should be of special service in standardising thermometers used for accurate physical-chemical researches, particularly in measurements of the freezing point of dilute solutions.

In the Proceedings of the American Academy of Arts and Sciences (vol. xli., No. 20) Prof. Theodore W. Richards and Mr. R. C. Wells deal with the possibility of utilising the

temperature of transition of sodium bromide dihydrate into the anhydrous salt as a fixed point in accurate thermometry. As the result of their investigations they conclude that when the salt is quite pure the transition of the dihydrate into the anhydrous salt takes place at a temperature of 50°.674 C., but that the exact value of the transition point is slightly modified by the presence of traces of impurity. Considerable difficulty is experienced in preparing pure sodium bromide free from sodium chloride; it cannot be obtained by re-crystallising the ordinary bromide, but must be made from pure bromine and pure sodium carbonate. Details are given of the methods used in purifying these materials, the sodium bromide ultimately obtained giving a value of 23.008 for the atomic weight of sodium; this value agrees closely with that recently found for the atomic weight by the same investigators using a method based on the analysis of sodium chloride.

THE variation of the properties of the hydroxyl group of alcohols as the nature and number of the alkyl radicals attached to the carbon atom are varied forms the subject of a suggestive paper by Prof. Louis Henry in No. 12 of the Bulletin of the Royal Academy of Belgium. The observations are of interest both from practical and classificatory standpoints. It is pointed out that as the number of alkyl groups is increased in passing from a primary to a tertiary alcohol, the properties characterising the hydroxyl pass from those associated with the hydroxyl radical of water to those characteristic of the hydroxyl of bases, such as potash. In particular the different behaviour is emphasised of the three classes of alcohols towards the halogen hydrides, towards acetyl chloride, and during esterification by means of hydrogen chloride and a fatty acid. The generalities established can be utilised as a means of predicting the behaviour of the mixed alkyl ethers when subjected to the decomposing action of the halogen acids.

A WELL-ILLUSTRATED price-list of sundials and sundial pedestals has just been issued by Messrs. Newton and Co. Many forms of horizontal and vertical dials, and also pocket dials, are described in the catalogue, which should be seen by anyone who desires to possess a timekeeper of this kind as a reminder of the days when hours were marked by shadows on a dial.

A COPY of the report for 1905 of the Rugby School Natural History Society has been received. It is to be regretted that "a distinct falling off in the keenness of the sections taken as a whole" during 1905 was, according to the preface, noticed by the officers of the society. It may be hoped that the present year will, by its exceptional exhibition of vigour, retrieve the character of what has been a hard-working society.

THE Journal of the Royal Sanitary Institute (vol. xxvii., No. 3) contains the full text of the important series of papers read at the conference on smoke abatement in December, 1905. The list includes the address by Sir W. H. Preece, K.C.B., on factory and trade smoke abatement; and papers on stoking, by Commander W. F. Caborne; on the abatement of smoke from factories, by Dr. S. Rideal; on the artificial production of persistent fog, by the Hon. Rollo Russell; on the destructive effect of smoke in relation to plant life, by Mr. Arthur Rigg; on the work of the Hamburg Smoke Abatement Society, by Mr. J. B. C. Kershaw; on observations on smoke densities, by Mr. J. W. Lovibond; and on the effect of smoke on plant life, by Miss M. Agar.

OUR ASTRONOMICAL COLUMN.

THE CONTINUOUS SPECTRUM OF THE CHROMOSPHERE.—An interesting communication dealing with the question of the existence of a continuous spectrum in the radiations emitted by the chromosphere was communicated to the Paris Academy of Sciences by M. Deslandres on March 26.

M. Deslandres made special preparations for the eclipse in August last in order to determine whether the continuous spectrum (*i.e.* the radiations emitted by solid or liquid *particles*) of the chromosphere is brighter, as bright, or less bright than that of the neighbouring corona. Employing coloured screens, which absorbed the gaseous radiations, he photographed the uneclipsed ring of chromosphere and corona directly, and, in order to determine what proportion of the transmitted radiations was due to the light emitted by the metallic prominences, &c., he simultaneously employed two grating cameras which disclosed the presence and intensity of the latter.

Comparing the images photographed through screens with similar ones obtained in the usual manner by Count de la Baume Pluvinel, it was seen that the former exhibited many striking peculiarities in the large group of prominences in the north-east quadrant. On the screen photographs the prominences were much shorter than on the ordinary photographs, whilst their base and a series of nuclei towards the north were much brighter than the other portions, features not noticeable on the ordinary negatives. Spectrograms of the corona secured at Palma by Dr. W. J. S. Lockyer confirmed the results of this comparison.

M. Deslandres concludes that these prominences did emit a continuous spectrum which was more intense than that of the neighbouring parts of the corona, and were far richer in incandescent particles. A programme for the prosecution of this important research in future eclipses accompanies M. Deslandres's communication (*Comptes rendus*, No. 13).

OBJECTIVE-PRISM DETERMINATIONS OF STELLAR RADIAL VELOCITIES.—Circular No. 110 of the Harvard College Observatory contains a brief description of some results recently obtained with the objective-prism method of determining radial velocities. In this method an exposure is made in the usual way, then the prism is turned through 180° and a similar exposure made, or the telescope may be reversed and the photographic plate turned through 180°. Stars with known velocities serve as standards for the displacement of the corresponding lines in the two spectra.

A reproduction of a spectrogram of the Pleiades, taken on January 29 with the 11-inch Draper telescope, is given in the Circular. On this plate about a dozen stars could be measured, and the probable error in the resulting velocities would be about ± 3.5 km. The scale is $52''.6 = 0.1$ cm., and the exposures were thirty-seven and thirty minutes respectively. On another plate, secured on January 29 with two exposures of about twenty minutes each, about 100 stars could be measured, although a number of them, owing to distortion at the edge of the plate, could only be employed to ascertain the corrections necessary.

In No. 2, vol. xxiii., of the *Astrophysical Journal*, Mr. Geo. C. Comstock discusses a similar method for determining radial velocities, but he proposes two similar direct-vision prisms placed in front of the objective. Formulæ for calculating the velocities from the measures obtained accompany Mr. Comstock's paper.

THE OBSERVATION OF LONG-PERIOD VARIABLES.—In Circular No. 112 of the Harvard College Observatory Prof. Pickering publishes a plea for the organised observations of long-period variable stars, observations which are especially suitable for amateur observers. In order to facilitate this work various catalogues of such stars have already been published by the Harvard observers, and a new one, bringing the results up to date, is now in the printer's hands. When published, copies of this catalogue will be given to all observers who can make use of it.

A number of enlarged copies of Father Hagen's charts of the fainter variables are also being prepared, and will be supplied at cost, or given, to observers qualified to use them. Instructions as to the improved method of making these observations are included in the present Circular.

GEOLOGY IN PRACTICE.[1]

IT will be sufficient to mention such names as the Black Hills, the Bighorn Mountains, the Foxhills and Laramie Range, and the Garden of the Gods to indicate that the preliminary report on the Central Great Plains (1) includes some classical and highly interesting ground. The area covered by the report comprises the greater part of South Dakota, Nebraska, and Kansas, and the eastern part of Colorado and Wyoming an area of no less than 1½ million square miles.

A good deal has already been written about one portion or another of this vast region; the first half of this volume gives a clear generalised account of the stratigraphy and structural geology of the whole; it is, however, by no means a mere abridgment of previously gathered information—it embodies the results of much original work.

From the time when the middle-Cambrian sea washed the Rockies and the adjacent highlands up to the latest physiographic conditions, the geological history of the region is here depicted in a broad manner. One feature of this country at once arrests attention, viz. the repetition in one epoch after another of widespread, uniform conditions of sedimentation—thus the great expanse of Dakota-Lakota sandstone in Cretaceous times, the equally widespread Arikaree sands of the Tertiary, and to-day the sandy alluvial deposits laid down by the rivers when they can no longer bear their load, and spread far and wide as the streams slowly turn from course to course. Less striking, perhaps, but equally widespread, are the argillaceous deposits like the Pierre shale of the Cretaceous. Here, as in other parts of the world, a series of "Red Beds" puzzles the geologist to place a limit to the top of the Carboniferous or the base of the Trias.

But it is not so much for the pure geology that this report will be read as for a guide—a very practical guide—to the sources of underground water. The general conditions governing the underground water system of the Great Plains are simple. A thick succession of alternating sandy and impervious sediments constitutes the rocky floor of the country. These beds are tilted up in the north and west, and dip thence gradually southward and eastward. Water-bearing beds are found in the Cambrian and in every other formation locally up to the recent hills of blown sand; but by far the most important is the Dakota sandstone, which spreads out as a great sheet 150 feet to 300 feet thick beneath the entire area of the plain. This sandstone is underlain by the Red Beds or by the Carboniferous limestone and shale, or, in East Dakota, by the Sioux quartzite; it is overlain by the great mass of clays and shales of the Benton, Niobrara, and Pierre formations. The principal zone of intake lies 4000 feet to 6000 feet above sea-level on the flanks of the Rocky Mountains and the Black Hills; as a result, high pressures are found in wells hundreds of miles from this region.

In this country we trust that the bearing of geological structure upon the amount and quality of water to be obtained in any given area is as well understood as it is across the Atlantic. Yet, although to be "like mother makes it" may express the excellence of a soup, the same can in no wise be said of geo-hydrological literature. We have a curious shyness about graphic modes of presenting information, a diffidence about making unavoidably clear, so that he who runs may read. It is in this direction that the volume under discussion excels, there are no fewer than fourteen maps, and twelve of these bear directly upon water-supply problems.

The landowner, the engineer, the manufacturer, rarely has the time or the requisite special knowledge to sift the information usually conveyed in records of well borings. He cannot afford to spend hours in the endeavour to discover whether the "ratchel" of one sinker is the "muck and rubble" of another, whether "blue bungum" can really be distinguished from "hard bind," or Kimmeridge clay from Gault. The geologist must know these things; what the landowner asks him is, How deep must I sink for water here? and How much may I expect to find? It is true that none but Providence or the "dowser" could answer these questions in terms of precise exactitude, but the report before us proves how much can be done by taking the subject seriously and by the application of graphic methods to focus the geological information in its varied forms into one or more simple images, so that even the "man in the street" can see at a glance what are the possibilities of any particular situation. The maps, in addition to giving the general geology, show also the underground areas occupied by the more important formations separately, and, by means of contours, the depth of the bed-rock beneath superficial deposits, the depth of the

FIG. 1.—"Toadstool Park" in badlands west of Adelia, northern Sioux county, Nebr. Sandstones overlain by Brule clays

most important water-bearing stratum, and the altitude of the head of water, as well as other useful information.

The volume is profusely and beautifully illustrated. Three of the plates, exhibiting forms produced by erosion, have been reproduced to accompany this notice.

Mr. Taff in his report (2) describes the structure and stratigraphy of the two groups of hills, the Arbuckle and Wichita Mountains, which rise abruptly, like islands, from the Red Rock plain in Oklahoma and Indian Territory, a region which lies south-east of that described in the previous report.

These two hill-groups have a common alignment, their axes trending north-westward and south-eastward. Their geological history appears to be identical; underlying the sedimentary rocks in each case are pre-Cambrian granites, granite-porphyries, and aporhyolites—the oldest rock is a gabbro, in the Wichita group. The succeeding Cambrian and Ordovician strata bear no evidence of folding; the period of uplift which has led to the exposure of the igneous pre-Cambrian rocks began in the middle of the Pennsylvanian (Carboniferous) epoch and culminated near its close, before the deposition of the Red Rocks (? Carboniferous or Permian) which in this region constitute the prevailing surface rock.

We are glad to see that the field staff records its appreci-

[1] Reports of the United States Geological Survey. (1) Preliminary Report on the Geology and Underground Water Resources of the Central Great Plains. By N. H. Darton. 1905. (2) Preliminary Report on the Geology of the Arbuckle and Wichita Mountains in Indian Territory and Oklahoma. By J. A. Taff. With an Appendix on Ore Deposits by H. Foster Bain. 1904. (3) The Geology of the Perry Basin in South-eastern Maine. By G. O. Smith and David White. 1905

ation of the arrangement by which the palæontologists were enabled to accompany the party—a very proper plan, and one which in this case greatly facilitated the speed and exactness of correlation and mapping, besides accumulating material for an important monograph on the fossils.

The report contains two geological maps and several views of the scenery. An appendix on the reported ore deposits of the Wichita Mountains, by Mr. H. Foster Bain, should be of use as a warning to prospectors.

(3) Henceforth let no man say there is coal in Perry. For seventy years have the dwellers in south-eastern Maine cherished the hope that coal lay within their borders; and had they not good reason? Perry lies near the edge of a structural basin, and they had been told that the "Perry" beds were Triassic, consequently that coal might be found beneath them; the Canadian Geological Survey had coloured the beds Carboniferous on their map—in spite of Sir William Dawson's diagnosis of the plants—and mining "experts," glancing at the same obscure plant remains, had said, "Here you are, the very thing," and had gladly bidden the people to bore; and they bored, through the Perry beds into the Silurian lavas, but into no coal. Still in hope, the sum of 15,000 dollars was asked for to put down more bore-holes; it was decided, however, first to call in the aid of the U.S. Geological Survey Department, with the result that Messrs. Smith and White were sent to examine the ground. Then, hey presto! the obscurity vanished—a ten days' reconnaissance was enough. There is no coal in the Perry beds, only conglomerate with a little sandstone and shale and interstratified basic lava. Subsequent examination of the badly preserved plants confirmed the age of the beds to be Devonian, probably Chemung, and, incidentally, produced two new generic types. The plants are figured in six plates.

J. A. H.

Fig. 3.—"Jail Rock," showing castellated form of weathering of Gering sandstone and slopes of Brule clay; valley of North Platte in the distance.

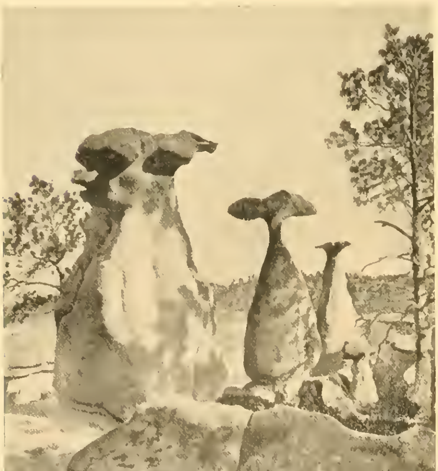


Fig. 2.—Eroded Sandstones, Monument Park, Colorado.

STUDIES OF TEMPERATURE AND PRESSURE OBSERVATIONS.

METEOROLOGISTS will be interested in a paper recently published by Dr. van Rijckevorsel, and entitled "Konstant auftretende secundare Maxima und Minima in dem jährlichen Verlauf der meteorologischen Erscheinungen," part ii. (Rotterdam: Van Hengel, 1905). This is really the second portion of a previous publication, only in this instance the number of stations dealt with is more numerous, and the stations themselves more generally distributed over the earth's surface.

By the method explained in the pamphlet the author has obtained for twenty-two stations the mean annual temperature variations, the resulting curve representing the mean of observations of altogether 3636 years. The author then proceeds to eliminate the annual period of twelve months, and also discusses the residuals. The main result at which he arrives is that, no matter whether he deals with all the observations collectively, with the European stations alone, or with stations collected in north or south hemispheres, there is over the whole earth's surface during twelve months a half-yearly period of temperature the epochs of which are identical. It shows maxima in the beginning of March and September, and two minima in the first days of June and December. Another oscillation which is referred to is one composed of a series of very small maxima and minima.

With regard, however, to the six-monthly oscillation of temperature, a variation which seems to be clearly marked, it is interesting to note that the epochs of maxima seem to pick out the times when the north and south poles of the sun are consecutively turned towards the earth.

As the author finds that stations representing the north and south hemispheres give practically identical results, it would be interesting if he would try an east and west system of grouping of stations, and see if the same result is obtained. In the light of recent work, it seems quite possible, but not probable, that if stations in North-West Africa, South and North America, Honolulu, and Siberia be formed into one group, and the rest of the world into another, the same variation, but of opposite or nearly opposite phase, might be the result. The attempt is well worth trying, since the author has all the material at his hand, and the more stations employed in South America to counterbalance the larger number used and more easily obtained in the European area the better. In this pamphlet curves are given showing the variations derived, and

numerous tables containing the data for stations which possess observations extending more or less continuously over fifty years or more.

In a recent number of the *Meteorologische Zeitschrift* (January) Prof. Hofrat Hann has contributed a new determination of the mean temperature of the earth's atmosphere. In the second edition of his classical "Lehrbuch der Meteorologie," recently noted in this Journal, he gave us the results of a discussion of the material then available, but the publication of more data by Prof. Mohn dealing with the air temperature in the region of the North Pole renders a slight modification of the mean values necessary.

Prof. Mohn has just completed a study of the meteorological observations made during Nansen's memorable North Polar expedition in 1893–6, and has been able to make a new determination of the mean temperatures of the air for the parallels of latitude 60° to 90° north. These new values have enabled Prof. Hann to re-calculate afresh the mean temperature of the whole northern hemisphere, using the results obtained in the investigation of Spitaler for the parallels from 0° to 55° N. The value obtained for the mean of the northern hemisphere was finally 15°·1 C. For the southern hemisphere Prof. Hann had previously determined the value to be 13°·6 C., so that the mean value for the whole earth comes out as 14°·35 C. It is interesting to remark that the northern hemisphere appears to be 1°·5 C. warmer than the southern. Spitaler in 1886 came to a similar conclusion, his figures being:—

Northern hemisphere	15°·4 C.
Southern hemisphere	14°·8 ,,
Whole earth	15°·1 ,,
Excess of N. over S.	0°·6 ,,

Prof. Hann points out that the meteorological observations made during the recent Antarctic expeditions will be of special interest in relation to this question, since a new and better determination of the value for the southern hemisphere is rendered possible.

Attention is directed to the investigation of Prof. Supan, who formed the mean air temperatures into two groups, namely, east and west hemispheres, the dividing lines being 20° W. and 160° E. In this case the eastern hemisphere appears to be the warmer, as can be judged from the following mean temperatures calculated by Prof. Hann:—

	Hemisphere West	Hemisphere East
North Pole to equator ...	14°·6 C. ...	15°·6 C.
North Pole to 30° N. ...	5°·0 ,, ...	5°·4 ,,
30° N. to equator	24°·1 ,, ...	25°·8 ,,
Equator to 30° S.	23°·1 ,, ...	23°·6 ,,
Equator to 50° S.	19°·6 ,, ...	19°·4 ,,

It is only when more southern latitudes are included in the regions investigated that the resulting values give an excess of temperature for the western hemisphere.

In the northern hemisphere the land exceeds the water surface, while the opposite is the case in the southern hemisphere. The figures given above for these districts indicate, therefore, that the land has a capacity for raising the mean temperature of the air, the temperature of the northern in excess of the southern hemisphere being 1°·5 C.

According to General Tilto, there is a greater proportion of land to water in the eastern than in the western hemisphere, the values being

	Per cent. land	Per cent. water
Western Hemisphere (80° N. to 70° S.) ...	17 ...	83
Eastern ,, ,, ,, ...	37 ...	63

From this, therefore, the eastern hemisphere should be warmer than the western. The above figures show that this is actually the case, thus corroborating the deductions made for the relative temperatures of the north and south hemispheres.

In an article which appeared in these columns in 1904 (vol. lxx., p. 177) entitled "A World-wide Barometric See-saw," an account was given of the results of a study by Sir Norman Lockyer and myself of barometric changes of short period, which brought to light the existence of two large regions on the earth's surface, antipodal to one another, which behaved in an inverse manner to each other. In this article a chart was given illustrating the distribution of the different types of pressure variation, and it was pointed out that the further any station was placed from the centres of the two main regions, namely, India and Cordoba, the less the barometric variations were like those of these two regions.

In a recent paper by Dr. Wilhelm Krebs, of Grossflottbek, entitled "Barometrische Ausgleichsbewegung in der Erdatmosphäre" (*Das Weltall*, Jahrgang 6, Heft 8, p. 118), the distribution of this short-period barometric change is discussed, and the author constructs an isophase chart from some of the data published in the original communication from which the above-mentioned article was an abstract.

The method adopted by Dr. Krebs is to call the Indian (Bombay) barometric change 100 per cent., and determine the percentage of the changes in relation to India at nineteen other stations distributed over the earth's surface. This procedure is really not valid, because there are two stations, namely, Bombay and Cordoba, which should both be taken as 100 per cent. each, the one positive and the other negative. Calling Bombay 100 per cent., Dr. Krebs deduces Cordoba as 31 per cent.! Since the Cordoba pressure change is the inverse of that of Bombay, it is difficult to see how the 31 per cent. is obtained. Further, the chart becomes very misleading, for the isophase lines connect up places which have a totally different short-period barometric variation. Thus, for instance, his 70 per cent. line passes through Norway and Sweden, European Russia, Arabia, the Indian Ocean, and Australia. The pressure changes in the latter three regions are closely similar, but all very different from those existing in the first three regions named.

As a matter of fact, the chart already referred to as published previously in this Journal was really an isophase map. In it each of the different signs there adopted, namely, +, +?, −, −?, &c., represented types of barometric changes, the + signs, for instance, representing all places which behaved like India, and therefore represented as 100 per cent. according to Dr. Krebs's method. A more minute differentiation than this seems at present impossible until a much larger number of stations are employed in the survey.

William J. S. Lockyer.

THE MINERAL WEALTH OF ALASKA.

Recent developments have shown that Alaska as a mining field stands in the front rank among the possessions of the United States. Its annual gold production represents a value of some 1,600,000*l*. It produces silver, copper, and coal in considerable quantities, and its recently discovered tin and petroleum deposits are of great promise. During the past year the investigation of the mineral resources of Alaska has been energetically carried on by the United States Geological Survey under adverse conditions, and the Bulletins (Nos. 259, 250, and 236) recently published by Mr. A. H. Brooks, Mr. G. C. Martin, and Mr. C. W. Wright afford striking evidence of the excellent work that is being done in this direction by officers of the survey. Attention has naturally been directed chiefly to the gold placers. The placers of the Seward Peninsula, a field embracing an area of 20,000 square miles, still hold the first place in gold production in Alaska. Seven distinct types of alluvial gold deposits are met with in Alaska:—

(1) Creek placers, at the level of small streams.

(2) Hillside placers, on slopes.

(3) Bench placers, in ancient stream deposits 50 feet to 300 feet above present streams.

(4) Gravel-plain placers, in the coastal plain of Seward Peninsula.

(5) Sea-beach placers, on shore to which waves have access.

(6) Lake-bed placers, in beds of present or ancient lakes.

(7) River-bar placers, on gravel flats near the beds of large streams.

The mining of placer gold in Alaska is carried on during June, July, August, and September; and mining operations are rendered difficult not only by the short available season, but also by the lack of fall in the streams, the poor supply

of water and timber, the half-frozen condition of the gravel, and the high cost of labour and transport. In spite of these obstacles the wide and uniform distribution of alluvial gold, the healthy climate, and the proximity of the phenomenally rich goldfields of the British Yukon territory justify prospecting and mining for gold over so extensive an area. The methods of gravel and placer mining in vogue are well described by Mr. C. W. Purington. Hydraulic methods are the favourites, and the construction of the requisite ditches has gone on with great activity, about a hundred miles being under construction and a similar length in use. In the Porcupine district in south-eastern Alaska, near the international boundary, hydraulicing has proved economical. The gravel is attacked in this way, and sluice-boxes are lain on bed rock, everything being worked into them by the powerful stream from the hydraulic nozzle.

Of the gold-ore deposits in Alaska by far the most important is that of the Alaska-Treadwell mine on the eastern side of Douglas Island. The ore bodies consist of mineralised albite-diorite occurring in the form of intrusive dykes in black slates. The dykes are distributed throughout a zone about 3000 feet in width, extending along the strike for three miles. The ore consists mainly of rock impregnated with pyrites, in part filled by veins of calcite and quartz. The average value of the rock mined is 8*s.* per ton. The ore dykes have been developed along the dip for a distance of about 1000 feet. Hot ascending solutions, possibly of magmatic origin, appear to have been the cause of mineralisation, and the evidence is in favour of only one period of concentration.

None of the metals of the platinum series has yet been found in the Alaska alluvium, but stream tin discovered on the Anikovik River in 1900 has been found over an area of 450 square miles. During the season of 1904 development work on tin lodes was in progress at Lost River and Cape Mountain, and new discoveries of tin lodes were reported at Brooks Mountain, Ears Mountain, and in the Darby Mountains, all in Seward Peninsula.

The attempts to develop petroleum fields in Alaska which were begun in 1901 have been continued, but so far without any commercial production.

Promising surface indications of petroleum have, however, been found in the Controller Bay, Cook Inlet, and Cold Bay fields. Though only a few wells have been bored, Mr. Martin's studies have shown that there is ample justification for further prospecting, and that the Pacific Coast region of Alaska may prove an important source of illuminating oil. In this connection it is of interest to note that the Bering River coal is the best that has yet been found on the Pacific Coast. An average of twelve analyses showed 75·65 per cent. of fixed carbon, 15·06 per cent. of volatile matter, 7·07 per cent. of ash, 1·30 per cent. of moisture, and 1·24 per cent. of sulphur. Coal, mostly of a lignitic character, is also widely distributed in south-western Alaska, whilst the coals of the Cape Lisburne region are of two distinct classes, low-grade bituminous coal of Mesozoic age, and high-grade bituminous coal of Palæozoic age. The former covers an area of 300 square miles with 150 feet of coal in forty or fifty seams, ten of which seem to be of economic importance. The Palæozoic coals are also undeveloped. They occur in limited areas, and the beds are much crumpled and broken, so that mining will be difficult and expensive. The product will, however, probably command as good a price as the best coals shipped to Alaska.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—The electors will proceed to the election of a Sibthorpian professor of rural economy on June 9. The professorship has now been made tenable for life, subject to the liability of the holder to vacate it by deprivation for sufficient cause. The present stipend of the professorship is about 700*l.* a year.

Cambridge.—Applications for the John Lucas Walker studentship, the holder of which must devote himself (or herself) to original research in pathology, are invited, and should be sent, accompanied by references—not testimonials—not later than May 8, to Prof. G. Sims Woodhead, Pathological Laboratory, New Museums, Cambridge, to whom also applications for further information regarding the studentship may be addressed. The studentship is of the annual value of 200*l.* (grants may also be made for assistance and apparatus), and is tenable, under certain conditions, for three years from July 1.

Mr. Earle has been appointed to succeed Sir A. Pedler as Director of Public Instruction in Bengal.

Dr. J. Moeller, of Gratz University, has been appointed professor of pharmacognosia in Vienna University in succession to Prof. von Vogl.

Prof. J. Precht has been appointed to succeed Prof. Dieterici as professor of experimental physics in the Technical High School, Hanover.

Prof. Dr. E. Knoevenagel has been appointed director of the Heidelberg University chemical laboratory in succession to Prof. Theodor Curtius, ex-prosector of the University; while Prof. A. Klages has been deputed to take Prof. Curtius's lectures on experimental organic chemistry.

It has been decided to add to the University of Nancy a new physical institute, toward the cost of which the Government has promised 300,000 francs, while a further contribution of 50,000 francs has also been announced. This will mean that, apart from buildings for the medical faculty, there have been added within quite recent years new institutes for chemistry, electrotechnics, and applied mechanics, whilst the brewing school has been newly organised.

It is announced in *Science* that Mr. Andrew Carnegie has given 400,000*l.*, in addition to previous gifts, for the maintenance of the Carnegie Technical Schools, Pittsburg. From the same source we learn that by the will of the late Andrew J. Dotger, of South Orange, N.J., the Tuskegee Institute will receive 131,000*l.* on the death of his wife. It is also interesting to record that about 10,000*l.* has already been raised for the new professorship of lumbering in the Yale Forest School of the 30,000*l.* which is sought as an endowment. In fourteen western States 8800*l.* was raised from sixty contributors.

Among the courses of lectures to be held during May, arranged for advanced students and others in connection with the University of London, the following may be mentioned. A course of about seven lectures on the morphology of the Bryophyta will be given at the Chelsea Physic Garden by Prof. J. B. Farmer, F.R.S., beginning on May 8; a course of eight lectures on the physiology of nerve will be delivered in the physiological laboratory of the University by Dr. N. H. Alcock, commencing on May 8; and a course of four lectures on the atmospheric circulation and its relation to weather will be given on May 1, 8, 15, and 24 by Dr. W. N. Shaw, F.R.S.

In the Journal of the Royal Sanitary Institute (vol. xxvii., No. 3) Dr. G. Reid gives drawings of a new type of elementary school now adopted by the Education Committee of Staffordshire. The central hall type of building hitherto in favour was found to present difficulties in making adequate provision for ventilation by natural means, and a plan of building was adopted in which one semi-detached hall would serve for three departments, the class-rooms being designed in pavilion form with veranda communication. The cost of erection of the new type is considerably less than that of the central hall type, the cost of schools to accommodate 1020 and 628 children respectively being 10*l.* 10*s.* and 11*l.* 1*s.* in the former case as compared with 15*l.*, which was the average cost per head of the central hall type of building.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"On the Inheritance of Coat Colour in Horses." By C. C. **Hurst**. Communicated by W. Bateson, F.R.S.

Analysis of the Stud Book shows that in thoroughbred horses chestnut is a Mendelian recessive to bay and brown, which are dominants. Omitting other colours, it appears that when mated with chestnuts, bays and browns are either (*a*) pure DD, giving no chestnut foals, or (*b*) DR, giving, on an average, equality of chestnuts and of dominants.

Chestnuts mated with chestnuts (of any ancestry) breed true to chestnut, with about 1 per cent. of exceptions (9 in 1104), which may perhaps be due to errors in the records.

These observations differ from those of Prof. Pearson, who found no intrinsic difference between the inheritance of chestnut and other colours (Phil. Trans., A, vol. cxcv.), and has declared (*Biometrika*, ii., p. 214) that Mendelian principles do not apply to horse-colours.

(*Note added January* 31.)

In the paper read January 18 Prof. Weldon disputes these conclusions, while admitting that chestnuts breed true with about 1·5 per cent. of exceptions. His argument depends on the recorded exceptions. The Stud Book is very accurate, but many of the records are afterwards corrected, and there is sufficient margin of demonstrable error to make it possible that the rare exceptions which cannot be eliminated may be due rather to mistake than to physiological peculiarity in the animals. Very few of the supposed exceptions have appeared in public uncorrected. Genuine exceptions may perhaps occur, but the returns have scarcely the extreme precision necessary to establish such occurrences. Similarly the records show occasional exceptions to the purity of the pure dominants—about 1 per cent.

It is no doubt by including the families in which these exceptions occur among those from the DR dominants that Prof. Weldon has found a large excess of dominants from the mating DR × R.

Finally, the distinct properties of chestnuts must be ascribed to segregation and not to ancestry, for their behaviour in heredity is entirely different from that of bays and browns, though their ancestral composition may for several generations have been the same.

January 25.—"Observations and Photographs of Black and Grey Soap Films." By Herbert **Stansfield**. Communicated by Prof. Schuster, F.R.S.

This paper describes some work on soap films that originated with an examination of the two kinds of black films, undertaken in connection with a continuation of Reinold and Rücker's researches on soap films. The two kinds of black soap film were first described by Newton. Reinold and Rücker made electrical measurements which indicated that one black film was twice the thickness of the other, and this result has been confirmed by Johonnott's measurements with a Michelson interferometer. Johonnott found that the limiting thickness of the thicker black was 12 $\mu\mu$ (micromillimetres), after which it changed abruptly to the thinner black, 6 $\mu\mu$ thick.

Vertical plane films were examined by reflected light with a low power magnification, and it was found that the abrupt change from the thicker to the thinner black could readily be observed with films made from a solution of sodium oleate in water. It was also found that the change from one black to the other was the last and most striking of a series of similar changes that take place as a film thins. The process of thinning appears to be continuous and gradual until a thickness of about 100 $\mu\mu$ is reached, but after that it is accompanied by a series of abrupt steps. The photographs, taken with a camera and film box made for the purpose, show the two black films and three stages between the coloured part of the film and the thicker black which are called the first, second, and third greys, the numbers increasing with the thickness as in Newton's orders of colours.

The photograph reproduced in Fig. 1 shows a vertical frame, made of thin glass rod, supporting a film which is in the act of changing from the thicker to the thinner black; the small white discs that are formed on the advancing boundary of the thinner black appear to consist of material removed in the process. A narrow line of the first grey and traces of the thicker greys can still be seen between the coloured part of the film and the black.

A film shut up in an air-tight glass cell containing some of the soap solution does not thin beyond the thicker black stage if the equilibrium between the film and the water vapour is not disturbed. The thinner black is formed if

FIG. 1.—Oleate of soda film. Magnification 9. Photograph showing formation of the thinner black, and remnants of the grey stages.

evaporation takes place from the film; it may be produced by bringing a light near to the cell. Johonnott has recently shown that the same effect can be produced by a sudden increase of pressure in the cell. The change back again from the thinner to the thicker black, or to still thicker stages, can be produced by causing water vapour to condense on the film.

The paper also deals with the formation of the coloured patches which are often seen moving down through a coloured film. They have round heads and drawn out tails, and bear some resemblance to tadpoles. The head often shows concentric rings of colour, indicating that it is like a convex lens in shape. These tadpoles, or lens-

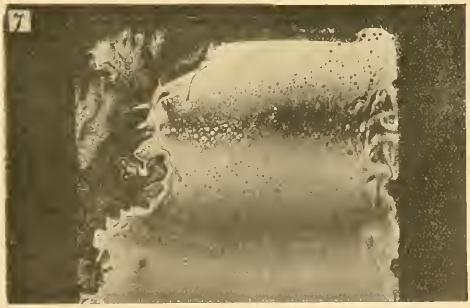


FIG. 2.—Oleate of potash film. Showing a growth of solid material on the left side, and lens-shaped thickenings falling through the coloured part of the film.

shaped bodies, often have their origin in minute grains which form in the black at the top of the film.

Fig. 2 shows the way in which solid material sometimes grows in a film. The film represented, instead of thinning in the usual way and becoming all black, only developed a few millimetres of black at the top, and then continued for hours to produce swarms of lens-shaped thickenings. When a film is behaving in this way, the grains in the

black and the lens-shaped thickenings in the coloured part of the film may be seen shooting into the tips of the dendritic growth of solid material.

The separation of solid matter in a soap film is probably connected with the formation of solid pellicles on the surfaces of aqueous solutions, which has been described by Ramsden, and it supports the theory of churning, advanced by Agnes Pockels, that the butter separates out in the bubbles formed in the churning process.

A film which is thinning rapidly owing to rapid evaporation often develops a curious "grey pattern" when a considerable amount of black has been formed. This pattern sometimes shows five or six grey stages of thickness, and seems to be produced by material spreading out into the film from thickenings which have accumulated during the thinning process.

It is suggested that the grey pattern, the grains in the black, and the lens-shaped thickenings are formed, like the solid growths in the films, by the concentration of the soap solution.

February 15.—"The Influence of Increased Barometric Pressure on Man. No. I." By Leonard **Hill**, F.R.S., and M. **Greenwood**.

The results of the present investigation show that

(1) A man can be submitted to a total pressure of seven atmospheres without untoward effects, provided decompression be effected gradually, and the capillary circulation be aided by repeated contractions of muscles, joint movements, and changes of posture.

(2) There is no sense of increased barometric pressure so long as the former is constant.

It is probable

(1) That the subjective effects of increased pressure, apart from voice changes and lip anæsthesia, depend upon psychical conditions, such as anxiety and excitement.

(2) The changes in the percentage of carbon dioxide in the alveolar air are conditioned solely by physical variations, and not by any increase or diminution in the respiratory metabolism.

In conclusion, the authors remark that they were unable to find any evidence in support of Snell's opinion ("Compressed Air Illness, or so-called Caisson Disease," London, 1896, Lewis, p. 212) that the presence of CO_2 in the respired air exercises a peculiarly unfavourable influence under increased pressure. Thus in one experiment the percentage of CO_2 in the chamber air, at +31lb., was 0·62 (equivalent to more than 1·8 per cent. at +0), and no untoward results occurred on decompression.

Society of Chemical Industry (London Section), April 2.—Mr. A. G. Salamon in the chair.—Ropiness in flour and bread, its detection and prevention: E. J. **Watkins.** Breads most frequently attacked by this disease are such as contain bran or low-grade white flours. In the present investigation it has been sought by means of culture experiments and the artificial production of ropiness in sound flour to establish the identity of an organism isolated from specimens of ropy bread and flour obtained in England. Cultures made from this bread yielded a small motile bacillus which, after repeated subculturing, was used in a series of experiments made with a known sound flour. Varying proportions of the culture were added to the water used for making dough. Such doughs when fermented showed no sign of bacterial effects, and the bread produced was of normal character when it left the oven. The bread when kept in a moist atmosphere at temperatures of 25° C. to 35° C. became ropy in about twenty-four hours. When the temperature was kept below 18° C. the disease did not appear. Dryness of the air generally prevented ropiness even when the temperature was high. Acids exercise a powerful influence in preventing the growth of the bacillus, it being found in a series of tests with varying quantities of acetic acid in the dough that the bread did not become ropy when kept long periods under conditions suitable to the bacillus. The cultural and microscopic characters prove the organism to be *Bacillus mesentericus* (Flügge).—The Röse-Herzfeld and sulphuric acid methods for the determination of the higher alcohols; a criticism: V. H. **Veley.** The two methods generally adopted for the determination of the higher alcohols are the Röse-Herzfeld (officially recognised in this country, Germany, and Switzerland) and the sulphuric acid method, adopted in France, consequently practised in this country, and officially used as a general qualitative test for the purity of all kinds of alcohol in Russia. Since these methods give very divergent results in the hands of different analysts, the author records various experiments to determine the accuracy or otherwise of the processes, and also criticises them.

Entomological Society, April 4.—Mr. C. O. Waterhouse, vice-president, in the chair.—Specimen of the very rare ant *Formicoxenus nitidulus*, a neuter, found in a nest of *Formica rufa* at Weybridge during the present month: H. St. J. **Donisthorpe.**—Specimen of *Platypsylla castoris*, Ritsema, a coleopterous parasite of the beaver, from France: G. C. **Champion.**—Specimens of a Noctua, believed to correspond to Dr. H. Guard-Knagg's original description of *Agrotis helvetina* ("Entomologist's Annual," 1872): W. S. **Sheldon.**—Examples of butterflies taken last year in Majorca showing injury to the wings, caused apparently by the attacks of lizards: A. H. **Jones.**—An account of the calcara observed on the legs of some Hymenoptera: Rev. F. D. **Morice.** The calcara were, the author said, quite constant in each species, and useful, therefore, as distinguishing characters, the only hymenopteron he had come across without them being the ordinary hive-bee. Kirby and Spence considered that they were used for climbing purposes, but this was unlikely, as the spurs occurred in species which did not climb at all. So far as he had noticed, they were used by members of this order for the purpose of cleaning their antennæ. Mr. C. O. Waterhouse said that similar spurs existed in the Trichoptera, though they did not assume beautiful forms as in the Hymenoptera; but as to their uses, he was not aware that any observations had been published or made on the subject. Mr. G. C. Champion remarked that they were also well developed on the hind-legs of some Coleoptera.

Linnean Society, April 5.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Some plants new to the pre-Glacial flora of Great Britain: Clement **Reid.** Fifty photographs were exhibited derived from material procured at Pakefield, near Lowestoft. The remains were black, and therefore troublesome to photograph, but the specimens themselves could not long be preserved, as an efflorescence occurred, and they fell to pieces, but experiments were now being conducted with the view of permeating the fruits with paraffin, and so ensuring their preservation.—A second contribution to the flora of Africa: Rubiaceæ, and Compositæ part ii.: S. **Moore.** In a former memoir composite plants were alone dealt with. In the present paper are submitted descriptions of Rubiaceæ as well as of Compositæ. To the former natural order twelve new additions are proposed, referable to the following genera:—Otomeria, Oldenlandia, Heinsia, two species of Tarenna, Randia, Tricalysia, Polysphæria, and two species each of Canthium and Diodia. The Compositæ regarded as new number fifteen, of which Helichrysum claims six species; Vernonia, Inula, and Senecio two each, and Felicia, Bidens, and Dicoma one each.—The structure of the stem and leaf of *Nuytsia floribunda*, R. Br.: E. J. **Schwartz.** *Nuytsia floribunda* is a member of the Loranthaceæ and a native of West Australia, and, unlike other members of this order, it is non-parasitical and a tree attaining a height of some 30 feet.—Taiwanites, a new genus of Coniferæ from the Island of Formosa: B. **Hayata.** Dr. Masters considers the genus a valid one, judging from a small scrap which he had received from the author, who believed his new genus to be intermediate between Cryptomeria and Cunninghamia; he himself pointed out that it combined the foliage of Athrotaxis with the cone of Tsuga; in any case it is a very interesting genus.

Royal Astronomical Society, April 11.—Mr. W. H. Maw, president, in the chair.—Explanation of the apparent secular acceleration of the earth's orbital motion: P. H. **Cowell.** The author had found that certain arbitrary assumptions with regard to the sun and moon satisfied the conditions of six ancient solar eclipses. He concluded that it was wrong to assign an arbitrary secular acceleration to the moon and none to the sun, and to justify this by

supposed tidal influence. The rate at which the day increases appears to be 0.005s. per century, this being about ten times greater than previous estimates.—Planetary inversion: F. J. M. **Stratton.** The author had been led to this investigation by Prof. Pickering's suggested explanation of the cause of the retrograde motion of Phœbe, the ninth satellite of Saturn. It was assumed that at the time this satellite was thrown off from its primary the latter had a retrograde motion of rotation, which subsequently became changed to a direct motion by the inversion of the planet's axis. The author concluded that while the theory remains for the present a speculative hypothesis, it is supported by the theory of tidal friction, and gives the only explanation of certain facts that has so far been put forward.—High-level chromospheric lines and their behaviour in sun-spot spectra: Prof. A. **Fowler.** The observations showed that enhanced lines appear as high-level lines in the chromosphere, and that the corresponding Fraunhofer lines are generally enfeebled in the spectra of sun-spots.—Discussion of the Harvard observations of the eclipses of Jupiter's satellites, 1878–1901: Prof. R. A. **Sampson.** The author gave an account of this discussion, which will be published by the Harvard Observatory.

CAMBRIDGE.

Philosophical Society, March 12.—Dr. Fenton, vice-president, in the chair.—A theory of the widening of lines in the spectrum: Prof. J. J. **Thomson.** The view put forward is that the widening of the lines is due to resonance. The luminous molecules emit waves of light, and as these are also waves of electric and magnetic force, a luminous particle produces a strong electrical field in its neighbourhood; this will act on the vibrating electrified particles in a neighbouring luminous molecule, while this second molecule will exert similar forces on the first molecule. Two adjacent luminous particles thus exert forces on each other, and, if the natural periods of the two are equal, the action between them may result in a considerable change in the period. As the vibrating systems are surrounded by many systems, some at one distance and others at another, the changes produced in the periods will not be constant, but may have any value included between certain limits, the range between the limits increasing with the number of luminous molecules. This range in the value of the periods causes the original bright line to be spread out into a band.—The transmission and reflection of the radiation from radio-active substances: Prof. J. J. **Thomson.** The amounts of secondary, tertiary, and radiation of a higher order transmitted through and reflected from a plate of matter placed in the path of radiation from radio-active substances are calculated, and methods obtained for comparing the total ionisation produced by the secondary and other rays with that produced by the primary rays.—(1) The asymptotic expansion of the integral functions

$$\sum_{n=0}^{\infty} \frac{x^n \Gamma(1+an)}{\Gamma(1+n)} \text{ and } \sum_{n=0}^{\infty} \frac{x^n \Gamma(1+n\theta)}{\Gamma(1+n+n\theta)}.$$

(2) The asymptotic expansion of integral functions defined by generalised hypergeometric series: Rev. E. W. **Barnes.**—A method of following the course of certain chemical actions, and a period of induction in the action of water on monochloracetic acid: P. V. **Bevan.** The method described was to determine the resistance of the solution in which the chemical action was taking place. In dilute solutions, when an acid such as hydrochloric acid is set free as the action progresses, this method affords a very delicate way of observing the rate of decomposition. The action of water on monochloracetic acid was investigated, and was found, except just at the beginning, to follow the normal monomolecular course.—The radio-activity of metals and their salts: N. R. **Campbell.** Measurements of the activity of metals and their salts show that the radio-activity of ordinary materials is an atomic property. The identity in respect of this property of samples of the same salt prepared by different methods shows that the apparent activity cannot be due to impurity.—A relation between the velocity and the volume of the ions of certain organic acids and bases: T. H. **Laby** and G. A. **Carse.** A method of finding the relation between the velocity and linear dimensions of an ion is to calculate the latter by taking the cube root of the ionic volume found from the molecular and atomic volumes, and combine this with the ionic velocity. It is found that the product of these two quantities is approximately constant for the members of the homologous series which the authors have examined, viz. the fatty acids, amines, pyridines, and anilines, but varies from series to series.—A preliminary note on the maiotic phenomena in the eggs of the hermaphrodite *Angiostomum nigrovenosum* (*Ascaris nigrovenosa*): S. A. **McDowall.** The synapsis of the chromosomes is very clearly shown in this animal.—The reduction of the general ternary quintic to Hibbert's canonical form: H. W. **Richmond.**

DUBLIN.

Royal Dublin Society, February 20.—Dr. W. E. Adeney in the chair.—The vapour pressure of a pure liquid at constant temperature: Prof. Sydney **Young.** In order to find whether the statement contested by Battelli and others, that the vapour pressure of a pure liquid is independent of the relative volumes of liquid and vapour, is borne out by experimental observations, the author has collected together the results of his determinations of the vapour pressures of twenty-seven carefully purified liquids. He points out (1) that errors due (*a*) to the presence of dissolved air and other impurities, (*b*) to the vaporisation of mercury, and (*c*) to readings being taken too rapidly, would have the effect of making the observed pressures higher at small than at large volumes; (2) that those errors must be smaller when readings are taken during evaporation than during condensation; (3) that the errors are likely to be greater at high temperatures than at low ones. With twenty-one out of the twenty-seven pure substances, forty-five series of determinations were successfully carried out, the liquids having been almost free from air, and no signs of decomposition having been observed. There were 493 determinations of vapour pressure, each being the mean of, as a rule, four readings taken at different volumes. That the mean observed fall in pressure during evaporation for the 257 determinations at temperatures up to 180° was less than 1 in 10,000 may be regarded as a proof that the vapour pressure is really independent of the volume. At temperatures above 180° the mean fall in pressure for 236 determinations was 1 in 1450.—Views illustrating the permo-Carboniferous glaciation of South Africa: Prof. G. A. J. **Cole.**

March 20.—Prof. Sydney Young, F.R.S., in the chair.—Electromagnetic mass: Prof. A. W. **Conway.** This was a continuation, in an expanded form, of the paper read at the meeting held January 16.

PARIS.

Academy of Sciences, April 9.—M. H. Poincaré in the chair.—Some problems in mathematical physics appertaining to the equation of M. Fredholm: Émile **Picard.**—A means of controlling a system of clocks synchronised electrically: G. **Bigourdan.** In a system of clocks controlled electrically the synchronism may be disturbed owing to various causes. By the use of a galvanometer attached to each controlled clock, and the suppression of the directing current once in each minute, at the zero second, any deviation can be measured.—Concerning the presentation of a number of the "Catalogue photographique du Ciel" from the Observatory of Toulouse: M. **Lœwy.** This number is chiefly devoted to the measurements of the rectilinear coordinates of stellar images taken photographically with a view to the determination of the solar parallax by means of the planet Eros.—The transformations of systems of partial differential equations of the second order: J. **Clairin.**—The dichroism, double refraction, and conductivity of thin metal plates obtained by kathode pulverisation: Ch. **Maurain.** The effects described were shown most strongly by bismuth, but similar results were obtained with gold and nickel.—Gaseous osmosis through a colloidal membrane: Jules **Amar.** From the experiments described the author concludes that gaseous osmosis through the tissue employed is in accord neither with the experimental laws of Bunsen and Graham nor with the theories of Stefan and O. Meyer.—The variations of the absorption bands of a crystal in a magnetic field: Jean **Becquerel.** Some of

the results obtained can be most readily explained by assuming that certain bands correspond to the vibrations of positive ions.—The production of high vacua by means of liquid air: Georges **Claude** and René J. **Lévy**. The arrangement is based on the absorption of gases by charcoal at the temperature of liquid air.—The acoustic properties of certain halls for speaking: M. **Marage**. Experiments confirming the views put forward on the resonance of halls by Wallace Sabine.—The variations of some properties of quartz: H. **Buisson**. Two fine specimens of quartz were compared, measurements being made of their density, coefficient of expansion, double refraction, refractive index, and rotatory power. There were distinct differences between the two specimens, all the deviations being in the same sense. It is thus clear that quartz, even well crystallised, cannot be considered as a perfectly pure substance with absolutely defined properties, or even as a homogeneous body.—The radio-activity of springs of drinking water: F. **Dienert**.—Some pyrophosphoric compounds: J. **Cavalier**. The preparation and properties of the pyrophosphoric esters of ethyl, propyl, butyl, and amyl alcohols are described. They all proved to have molecular weights corresponding to the formula $R_4P_2O_7$, determined by the cryoscopic method.—Barium iodomercurates: A. **Duboin**.—The pure ferromolybdenums: Em. **Vigouroux**. In the direct combination of iron and molybdenum with the iron in excess, the definite compound Fe_2Mo is formed, and no other compound containing less molybdenum appears to be capable of existence.—The influence of the ketonic and acid grouping in the same molecule: L. J. **Simon**.—The condensation of the acetylenic amides with phenols. A general method for the synthesis of ethylene-oxyphenol amides: Ch. **Moureu** and J. **Lazennec**.—The genesis of an iron mineral: L. **Cayeux**.—A preliminary note on globoids and certain granulations of seeds, resembling the metachromatic corpuscles in some of their properties: J. **Beauverie** and A. **Guilliermond**.—The Khaya of Madagascar: H. **Jumelle** and H. Perrier **de la Bathie**. Reasons are shown for regarding this as a new species, *Khaya madagascariensis*.—Study of the variations of nitrogen and phosphoric acid in the juices of a grass plant: G. **André**.—The treatment of seed with copper salts: E. **Bréal**. The superficial sterilisation of seeds by copper solutions not only prevents cryptogamic diseases, but also causes a good utilisation of the reserves.—The heats of combustion and the composition of the bones of the skeleton of the guinea-pig, considered as a function of the age: J. **Tribot**.—The nucleus of the red blood corpuscles in birds: M. **Piettre** and A. **Vila**.—The Pleistocene glaciers in the valleys of Andorra and the neighbouring high Spanish valleys: Marcel **Chevalier**.—Contribution to the Tertiary flora of northern Morocco: Ed. **Bonnet**. Observations on moving shadows at sunset and sunrise: Cl. **Rozet**. The phenomenon of moving shadows has hitherto been observed only during an eclipse of the sun. The author points out the conditions under which the same phenomenon can be seen at sunset and sunrise.—Measurements of the variations of the gravitation constant in the Simplon Tunnel: Marcel **Brillouin**. The results of atmospheric studies in the region of the trade winds: L. **Rotch** and L. Teisserenc **de Bort**.

CAPE TOWN.

South African Philosophical Society, February 28.—Dr. J. C. Beattie, president, in the chair.—Rock specimens showing the occurrence of Glacial beds in the Griqua Town series of Hay: A. W. **Rogers**. Flattened and striated stones, the peculiarities of which can at present only be attributed to glacial agencies, occur in a hard ferruginous rock near the top of the Griqua Town series in Hay. They are of various sizes, from an inch or two up to 18 inches long. They consist of chert; a few grit pebbles are found, but as yet no granites or other igneous rocks are known from those beds; some hollows, now partly filled with specular iron, may represent limestone fragments. The boulders are scattered at wide intervals through the matrix in most cases, though gravelly grits also occur.—Under water in south-eastern Bechuanaland: A. L. **Du Toit**. The term south-eastern Bechuanaland is used as including the divisions of Mafeking and Vryburg as far westwards as Kuruman.—A set of linear equations connected with homofocal surfaces: Dr. Thos. **Muir**.

DIARY OF SOCIETIES.

MONDAY, APRIL 23.

SOCIETY OF ARTS, at 8.—Ivory: Alfred Maskell.

VICTORIA INSTITUTE, at 4.30.—Review of Sir Henry H. Howorth's "Ice or Water": Prof. Edward Hull, F.R.S.

WEDNESDAY, APRIL 25.

GEOLOGICAL SOCIETY, at 8.—Trilobites from Bolivia, collected by Dr. J. W. Evans in 1901–1902: Philip Lake.—Graptolites from Bolivia, collected by Dr. J. W. Evans in 1901–1902: Dr. E. M. R. Wood.—The Phosphatic Chalks of Winterbourne and Boxford (Berkshire): H. J. Osborne White and Llewellyn Treacher.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

SOCIETY OF ARTS, at 4.30.—Seistan, Past and Present: Colonel A. H. McMahon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews.

MATHEMATICAL SOCIETY, at 5.30.—Perpetuants and Contraperpetuants: Prof. E. B. Elliott.—(1) A Question in the Theory of Aggregates; (2) The Canonical Forms of the Ternary Sextic and Quaternary Quartic: Prof. A. C. Dixon.—On the Question of the Existence of Transfinite Numbers: P. E. B. Jourdain.—Some Theorems connected with Abel's Theorem on the Continuity of Power Series: G. H. Hardy.—On a Set of Intervals about the Rational Numbers: A. R. Richardson.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Ore Deposits and their Distribution in Depth: Prof. J. W. Gregory, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: Louis Greaven.

PHYSICAL SOCIETY, at 5.

AËRONAUTICAL SOCIETY, at 8.—The Use of the Balloon in the National Antarctic Expedition: Captain Robert Falcon Scott, R.N.—The Experiments of the Brothers Wright: Sir Hiram S. Maxim.

CONTENTS.

THURSDAY, APRIL 26, 1906.

THE NEW ORGANIC CHEMISTRY.

Chemie der alicyklischen Verbindungen. By Prof. Ossian Aschan. Pp. xlv + 1163. (Brunswick: Vieweg und Sohn, 1905.) Price 40 marks.

FEW reflections are more curious than those which contrast the manifold complexity of the organic chemistry of the present day with the crude simplicity of the fundamental conceptions upon which it has been built up. Broadly speaking, these conceptions are but two in number—first, the almost repulsively mechanical atomic theory of Dalton, which we still retain in practically its original form, and second, the irritatingly mysterious doctrine of valency introduced by Frankland and Kekulé, also still preserved much as it was enunciated, but which eludes our grasp and sets us chasing shadows so soon as we attempt to translate it into definite mechanical conceptions. Yet, on the ground-work afforded by these two conceptions, so irreconcilable in their nature and so hopelessly crude in the eyes of the physicist, the organic chemist has built up a purely experimental science which embraces hundreds of thousands of different substances within a scheme as perfect as any known to science, which classifies with similar perfection the reactions by means of which those substances are produced and the behaviour which they exhibit, and has led to the synthetic preparation of hosts of compounds the production of which our immediate predecessors regarded as amongst the most intimate secrets of animal and vegetable life.

This result has been attained by the systematic development of experimental methods, and by applying those methods, as they became sufficiently powerful, to the consecutive study of the diverse classes of compounds occurring in organic chemistry. Long ago, experimental methods were sufficiently strong to permit of their successful application to large numbers of aromatic compounds. To-day, the rough methods of the older chemists have become largely superseded by far more delicate ones, by methods which render possible the building up, piece by piece, of the fragile molecular structures numbered amongst the alicyclic compounds. The organic chemist has probably always realised the filamentary character of his hypotheses, and, knowing that he has no prophetic or far-reaching mathematical theory with which to eke out his own cunning, has been led to rely very largely upon his own manipulative skill. For this reason, and more especially is this the case in the branch of the subject now under consideration, organic chemistry partakes of the nature of an art as much as of that of a science, and to be successful, the organic chemist must be endowed with a sort of intuition which education cannot impart and instruction cannot destroy.

The systematic study of the alicyclic compounds dates back only some twenty-five years. At that time the wonderful successes achieved amongst the aromatic compounds by Kekulé and his followers seem almost to have suggested that all complex organic substances might be benzene derivatives. One of the most important alicyclic compounds known to us, namely, camphor, was formulated by Kekulé as an aromatic substance, and for long the Kekulé constitution for camphor held its own, in spite of objections raised by Armstrong and others. Gradually, however, as the early work of Freund, and especially of W. H. Perkin, jun., was developed, it became clear that benzene derivatives are not the only possible closed chain carbon complexes, and derivatives of 3, 4, 5, and 6 membered closed carbon chains were prepared synthetically; it was thus demonstrated that there exist in nature many important closed ring compounds which belong to a class totally different from that of the aromatic compounds, and which may be termed, as Bamberger first suggested, the alicyclic compounds.

A work like the present, which aims at giving a full and complete account of all that has been done in a subject which has grown so rapidly, and is even yet but in its childhood, is greatly needed, and probably no one is better equipped for successfully carrying out the colossal task involved in its production than Prof. Aschan, of Helsingfors. For the worker in this subject, such a book as Aschan has produced is invaluable, if only as an aid to the mnemonic arrangement of his knowledge, and for the student, face to face with the task of studying hundreds of lengthy memoirs, such a classified digest of the whole subject as is here provided offers invaluable indications as to what must be read and what may be safely disregarded.

The classification adopted in the work consists primarily of a division into a general and a special part; further, each division of the subject is ushered in by an historical introduction, which is both interesting and of considerable educational value as leading up, tersely and plainly, to the main theme. The general part includes an introductory chapter defining the scope of the subject dealt with, a theoretical discussion relating to the development of the subject, a discussion as to the influence of ring formation upon the chemical and physical properties of ring compounds, and an exposition of the stereochemistry of alicyclic substances. The special part comprises a systematic description of the methods of formation and preparation of alicyclic compounds, followed by a detailed and equally systematic presentation of our present knowledge of monocyclic, bicyclic, tricyclic, and polycyclic carbon compounds.

The variety of types and the complexity of detail involved in the study of the alicyclic compounds possibly make essential the primary division of the work into a general and a special part; the instances which can be quoted in which some repetition results from the introduction of a general summary as a preliminary to the detailed section are therefore, perhaps, unavoidable in a work of this kind. At the same time, any duplication of matter in the general summary and the detailed description has some drawbacks, because it increases the actual number of pages to be got through without essentially affecting the

amount of information which is imparted: and the stream of literature incessantly poured upon the unfortunate chemist is now so voluminous that few can attempt to read even the most interesting work in detail; the pages have to be merely skimmed through, and the task of forming and storing an adequate visualisation of the whole is possible only to the highly trained memory.

The general arrangement of the book, although highly systematic, sometimes leads to difficulties in finding any desired subject. Thus, the dihydrophthalic acids are dealt with on p. 827, the tetrahydrophthalic acids on p. 771, and the hexahydrophthalic acids on p. 702; yet all these substances were prepared by v. Baeyer at the same time and described in the same paper. The difficulty of finding one's way about the book would, however, be far greater were it not for the excellent index and detailed table of contents.

In the sections devoted to the terpenes and the camphor group, we cannot but miss the spirit of selection and criticism which lends such fascination to the account of the same branch of organic chemistry given by Prof. Harries in Meyer and Jacobson's "Handbuch der organischen Chemie." But, after all, Aschan's book is so replete with valuable detail that any serious attempt on his part to exercise the critical faculty might have impaired the usefulness of the whole work. At the same time, the value o the book as a comprehensive digest would certainly be the greater if more stress had always been laid on investigations which really mark an epoch. Thus, the brief mention made on pp. 501 and 563 of Perkin and Thorpe's recent synthesis of α-campholytic and isolauronolic acids appears quite inadequate in view of the way in which this synthesis cleared the field and settled definitely the question of the constitutions of these two important acids.

A similar objection may be raised in connection with the otherwise excellent discussion of the constitution of pinene on pp. 170 to 186, from which it is by no means easy for the casual reader to discern the really essential points in the complicated argument. The whole discussion relating to this problem centred for a long time upon the constitution of isocamphoronic acid, and for this Tiemann and Semmler offered the formula

$$HO.OC.CMe_2.CH(CH_2.CO.OH)_2,$$

whilst v. Baeyer suggested

$$\begin{array}{l} \quad\;\; CMe_2.CH_2.CO.OH \\ \qquad\;\; | \\ HO.OC.CH.CH_2.CO.OH \end{array}.$$

The discussion was settled once and for all by Perkin, who prepared both these acids and proved thereby that the Tiemann and Semmler constitution correctly represents isocamphoronic acid. No mention seems, however, to be made in the work of these two syntheses, although they are vital to the argument.

In such a comprehensive work as the one under consideration it is surprising that so few slips and omissions occur. On p. 22, lines 13 to 32, and p. 23, lines 10 to 37, the action of sodioacetacetic ester upon trimethylene bromide is stated, in accordance with the original paper of 1883, as leading to the formation of acetyltetramethylenecarboxylic ester,

$$CH_2\begin{array}{c} \diagup CH_2 \diagdown \\ \diagdown CH_2 \diagup \end{array}C\begin{array}{l} \diagup COMe \\ \diagdown CO.OEt \end{array},$$

but no mention is made of Perkin's subsequent demonstration that this reaction, both in the case of acetacetic and of benzylacetic ester, really leads to the production of oxygenated ring compounds, thus:—

$$\begin{array}{l} CH_2{-}CH_2{-}C.CO.OEt \\ | \qquad\qquad\quad \| \\ CH_2{-}{-}O{-}{-}CMe \end{array} \quad \text{and} \quad \begin{array}{l} CH_2{-}CH_2{-}C.CO.OEt \\ | \qquad\qquad\quad \| \\ CH_2{-}{-}O{-}{-}CPh \end{array}$$

although when sodiomalonic ester is employed a tetramethylene derivative actually results. The reaction is correctly stated in the special part of the work at p. 418.

Further, on p. 38, v. Baeyer's old condensation of three molecules of malonic ester into one of phloroglucintricarboxylic ester is still figured in all that simple symmetry which constitutes one of the glories of our elementary text-books. No mention is made of Moore's proof (*Trans. Chem. Soc.*, 1904, 165) that the product is really the phloroglucindicarboxylic ester of Bally, although v. Baeyer himself refers to the correction in his recently published collected works.

A curious slip occurs on p. 585 probably as the result of confusion with the work of Zelinsky—where Perkin and Haworth are represented as having prepared hexamethylene by the action of sodium on *bromocyclohexane* in boiling *alcoholic* solution, but where an equation is given representing the action of sodium on hexamethylene bromide. The synthesis was actually effected by the action of sodium on hexamethylene bromide in metaxylene solution; the action of sodium in boiling alcoholic solution would obviously have led to the production of normal hexane.

A valuable section is devoted to the discussion of the stereochemical relationships which may exist between isomeric alicyclic compounds, and the elucidation of the isomerism is materially facilitated by the use of carefully designed figures; the somewhat intricate stereochemistry of these substances can hardly be brought home to the reader more clearly than is here done. On p. 354 an erroneous constitution is assigned to isolauronic acid, and the deduction drawn therefrom that this acid can exist in four optically active modifications; isolauronic acid actually contains no asymmetric carbon atom, and, as is clear from the correct constitution assigned to it on p. 698, is incapable of exhibiting optical activity.

The section dealing with irone, ionone, and allied substances possessing the odour of violets forms a particularly lucid exposition of the finest piece of work done by Tiemann. Amongst the copious references given is to be noted one of the first fruits of the system of abstracting chemical patents introduced into the *Chemisches Centralblatt* during the last few years. Now that so much of the pioneer work in organic chemistry appears for the first time in patent specifications, references to the patent literature are

as necessary as references to the ordinary scientific journals.

In reading chemical compilations of German origin we are sometimes struck by the scant attention received by work done in this country, and are often forced thereby to the conclusion that the author's study of English chemistry is limited to the system of abstracts issued by the Berlin Chemical Society. No such fault can be found here; the author is obviously as much at home in the Journal of the Chemical Society as in the Continental journals, and gives full credit to all results, from whatever source they are derived.

For Aschan's new book, as a whole, nothing but praise is possible, and the few points to which objections have been made rank as nothing when regarded as raised from the perusal of a book 1200 pages long, which aims at giving a systematic account of the alicyclic compounds. The study of these substances has been mainly carried out at fever heat during the past quarter of a century, and the necessarily ragged way in which the results have been laid before the world in the current journals must have offered immense difficulties to the compiler.

We cannot close this book, containing as it does a lucid account of one of the most important and intricate sections of organic chemistry, without reflecting with pleasure that the intense but systematic work which has led, during the last twenty years, to the synthetic building up of such complex molecular structures as those of camphor and of the terpenes has been largely carried out in our own country.

W. J. P.

THE SYSTEM OF THE FIXED STARS.

Der Bau des Fixsternsystems mit besonderer Berücksichtigung der photometrischen Resultate. By Prof. Hermann Kobold. Pp. xi+256. (Brunswick: Vieweg und Sohn, 1906.) Price 5.60 marks.

To prove that the stars form a stable system is a problem that has had attractions for many philosophical minds. The problem has not been solved, possibly may not be capable of solution, but the attractiveness of the speculation remains. Analogy with the solar system has suggested, and given support to, such an idea. The harmony that is to be perceived in the ordered motions of the planets, permitting countless revolutions to be performed without permanent change or irregularity, might well give rise to the hope that the same principle that governs the solar system could be detected in the larger scheme of the stellar universe. Such an idea would naturally have sway at a time when speculation was little fettered by numerical data drawn from rigorous observation. If there was little evidence to support the notion, there was nothing to contradict it. Kant or Lambert could suggest without difficulty that the stability of the system was secured by each star moving in a definite orbit, which ensured the maintenance of the general form and arrangement. The influence that that thought has exercised on modern investigation is of more importance than the thought itself. To suspect the influence of the Milky Way in the scheme of the Cosmos, and to make its investigation the centre of inquiry, was to bequeath us a legacy which is by no means exhausted. Later schemes suggested by improved instrumental appliances have widened the scope and raised fresh issues, but the significance of the Milky Way remains. Similarly with the problem of the sun's motion, which a hundred years ago Herschel solved so satisfactorily, considering the character of his material. Disputed by Bessel and supported by Argelander and a host of later astronomers, the solution has passed through many stages and given rise to novel methods of treatment, involving the application of fresh hypotheses. In these later times we have pressed into the service the results brought to light by the spectroscope, especially difficult of interpretation as they are, and allowing the exercise of much ingenuity. But the essential problem remains the same. The only question is, What advances have we made in solving the riddle which perplexed earlier investigators?

In proportion as the problem becomes more and more complicated, either by repetition of similar processes or the introduction of fresh ones, the greater is the necessity for the examination of the evidence to test its value in combination, and of bringing the whole material to bear in one consecutive argument. This is the task which Dr. Kobold has undertaken, and in which he has acquitted himself with credit. One may not in every case draw the same conclusion, or with the same certainty, that the author does, but the evidence is at least presented with completeness, and we have the opportunity of bringing our critical faculty to bear upon the various lines of argument which are marshalled in review. Such a book is instructive to the tyro and suggestive to the expert. The one may adopt the conclusions which the author has drawn up, as indicating the general position of science towards this problem, the other may see the necessity for pursuing fresh lines of research, or of supporting alternative explanations of the results presented. In any case it is an advantage to see what has been attempted and what has been accomplished.

The author divides his book into three sections. In the first he describes on broad lines how the facts which may aid in solving the problem of the construction of the universe have been collected. The reader who comes fresh to this subject, without any previous acquaintance, gains an intelligent notion of the manner in which the positions of the stars have been ascertained, and can grasp clearly the supreme importance of an accurate determination of the precession constant when the question of proper motion is considered. The brilliancy and the colour of stars are both discussed, though the practical bearing of the latter point on this particular problem is not very clear, and in any case is more conveniently dealt with in discussing the spectroscopic observations, which are also brought under notice. Parallax and stellar distribution are adequately described, and therefore in this section we get a tolerably complete sketch of the main processes of stellar observation, except in-

the department of double and variable stars. Into the significance of variable, and especially of "new stars," the author does not enter. Doubtless he is well advised in considering the introduction of such topics premature, but the omission shows that we have a certain class of facts which cannot yet be brought into line with other data. We have not yet succeeded in weaving our information into a consistent whole.

In the second section we have the results of observation mainly as exemplified in the production of star catalogues, whether of place or of spectrum, of brilliancy or of distance, for in these catalogues, applying, as they do, to large areas in the sky, must be contained the information which is to solve the problem of the universe. No inconsiderable portion of this section is occupied with the question of proper motion and the proper method of its treatment. Here we have raised for us, in an acute form, the question of the parallactic as distinguished from the actual motion of the star, and the legitimacy of the assumption as to the absolute lawlessness of direction of the star's own motion. On this and similar points a certain amount of controversy exists, and Dr. Kobold is known to hold very definite views. Fortunately we do not consider it necessary to enter into any of these differences of opinion. We are simply concerned in pointing out the general direction to which the combined information points, and its bearing upon the existence of a stellar system. These conclusions Dr. Kobold collects in his third section, and, greatly daring, has summarised "on half a sheet of notepaper." This statement is so succinctly expressed that it may be reproduced almost literally. Throughout a finite space of spherical form are scattered bodies very different in mass and in physical conditions. With gaseous nebulæ at very low temperature occur other bodies in a condition of glowing heat and advanced condensation. The arrangement of the separate masses is not uniform; they are crowded together in clusters about certain centres of concentration. These groups possess a loose relationship, and are arranged in the form of a spiral having many branches. In the more distant parts of this spiral the hotter and gaseous stars predominate. The sun is comparatively near to the centre of this spiral, and the stars which stand in closest connection with it have also similar physical conditions. On the sun is impressed a motion towards a point in the Milky Way, the principal plane of the whole spiral, and a great number of stars near the sun participate in this same motion. Among the stars there are numerous groups having an apparent motion directed to points in the Milky Way. The stars of each group are in one plane, and their true motion, on the character of which definite information is still wanting, takes place in this plane.

This may seem a very small outcome for so much work, but it will hardly be urged that the author has erred on the side of caution. In any case this "Schlusswort" is valuable, since it expresses the opinion of one who is especially qualified to speak on a subject which possesses in an equal measure both interest and difficulty. W. E. P.

A PHYSIOLOGICAL STUDY OF THE BRITISH FLORA.

British Flowering Plants. By the Right Hon. Lord Avebury. Pp. xxiii+450. (London: Macmillan and Co., Ltd., 1905.) Price 15*s.* net.

LORD AVEBURY has given us in the past several delightful books on botanical subjects, dealing more especially with the forms and functions of leaves, flowers, and fruits. At the time when the earlier of these books were published there was a tendency to reduce botanical morphology to a cut-and-dried series of shapes and forms, each designated by a Latin name the correctness of which received more attention than the purpose served by the various modifications. In "Flowers, Fruits, and Leaves," and "British Wild Flowers in Relation to Insects," Sir John Lubbock adopted the more natural treatment of studying form in the light of function, with the result that on account of their broad conceptions and the appeal they made to the reasoning faculty, these books obtained a wide circulation, and even now they maintain their position among the foremost contributions to the subject. In the circumstances the author has drawn freely from his previous works in writing this volume, which is restricted to British plants, and contains shorter or longer references to all our flowering plants. It provides, therefore, a running commentary to British floras in general and to Bentham's "British Flora" in particular.

On the details of buds and stipules, a subject that Lord Avebury has studied very carefully, much information is provided. In the genus Lathyrus the shape of the stipules varies from the large foliaceous type of *Lathyrus maritimus* through the narrow sagittate stipules of *Lathyrus pratensis* to the minute, slender stipules that occur in *Lathyrus nissolia.* These and other forms found in the genus are collated, and it is pointed out how the shape fits in with the attachment of the leaf to the stem. The complex nature of the stipules of the hawthorn also receives elucidation. A full account is given of the winter buds of the beech, the pine, and the spruce. It will be seen from these that the examination and dissection of the winter buds of trees and shrubs provide a capital exercise for a nature-study class. Considerable attention has been paid to the dichogamous and diclinous conditions of flowers. The ordinary strawberry furnishes a good instance. Darwin distinguished female flowers producing plenty of fruit, complete flowers less fertile, and male flowers naturally bearing no fruit. Schulz observed for the same plant gynomonœcious, andromonœcious, gynodiœcious, and androdiœcious forms. This is only one of several types of variation in the flower that too frequently pass unnoticed. A certain amount of work has been published on floral variation, more recently by students of biometric problems, but there is plenty of opportunity for observations continued over a series of generations to obtain more definite conclusions on the subject of small variations.

An introductory chapter deals with categories and types, as for instance, flowers of water plants,

methods of protection of the flower against rain, &c. The table on p. 18 collating the modes of dispersal of the fruits of our trees and shrubs brings out the facts very distinctly, and similar tabulations will readily suggest themselves. With regard to the individual descriptions, it seems a pity that many are so short and that the vegetative parts have not received more consideration, but obviously in the limits of a single volume this could not be managed. The absence of technical terms, except for the few that are defined in the glossary, renders the book available to all interested in botany. The book is confined mainly to elementary topics, but students of advanced botany will find that they also can learn much from the information supplied, and can obtain not a few references to questions awaiting explanation or requiring more evidence to verify the explanations that have been offered. The illustrations are numerous, well produced, and appropriate.

OUR BOOK SHELF.

Rowing and Track Athletics. Pp. ix+449. The American Sportsman's Library. Edited by Caspar Whitney. Rowing, by Samuel Crowther. Track Athletics, by Arthur Ruhl. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1905.) Price 8*s*. 6*d*. net.

IN this book the history and progress of rowing and track athletics in America are described in a very interesting manner. From the British sportsman's point of view the book will be read with very great pleasure, for it shows how eagerly the Americans have strived, and not in vain, to excel the prowess of the athletes this side of the Atlantic. From the scientific point of view this history is also of value, for it shows the evolution of ideas which have culminated in the present methods.

The old order changeth for the new, and a race cannot now be won as in the old days, when it was customary "to have your friends out in boats on the course and to impede the other crew as much as possible; the race was not always to the swift—if the home man happened to be the slower," as the author here narrates.

At the present day the successful oarsman or track athlete is he who is able to combine with the greatest efficiency a number of variables. In the case of the former, some of these variables include personal fitness, easiness of style, length of oar and width of blade to suit his particular capability, length and weight of boat, and alertness of brain to take advantage of prevailing conditions and possibly unforeseen eventualities.

In this book we see how hard the struggle has been in America to acquire efficiency, and possibly the reason why. In many national characteristics climate plays a very important part, and, in the case of rowing or track athletics, the influence of climate can be clearly detected. The British style of rowing, for instance, has been evolved by Britishers under British weather conditions. The lines on which this efficiency has been secured need not, and should not necessarily, be identical with those evolved in America, since the climate of the latter country is so different from that of the British Isles.

In track athletics the same principle holds, and this is borne out by the fact that, on the average, the American is the fastest sprinter, while the Britisher is best at long distances. In fact, as the author states, "There is, undoubtedly, something magnetic in our American air, at least in the sort of atmosphere that is found in the north-eastern Atlantic States. . . . What the English climate lacks in this stimulating effect it seems to make up in its general soothing and nourishing influence, and if the athlete who has been bred in it is deficient in snap and nervous spring he is strong in endurance and vitality."

Without going into further detail, the reader must be left to read the book for himself. The illustrations, though not very numerous, are typical, and a capital index concludes the volume.

Économie Forestière. By G. Huffel. Tome Premier. Pp. ix+422. (Paris: Lucien Laveur, 1904.) Price 10 francs.

FRANCE has always taken a leading part in sylvicultural science, and the above volume is a good indication of the thorough manner in which this nationally important subject is practised in that country. The French Government has learned by past experience the disastrous results which the injudicious destruction of the forest inevitably brings, but at the same time France can furnish unrivalled examples of the benefits of proper forest management and administration.

The present work is divided into four parts. The first part deals with the use of the forest, both as regards the production of materials applicable to the needs of man and the beneficial influence it has upon the climate. A very interesting historical summary is given of the uses to which the forest was formerly put. This was pretty much the same in all countries, viz. the chase and pasturage. Then came the time when the forest was principally of value in regard to its wood production, especially in France, for firewood, until this was to some extent superseded by coal and other substitutes. A most interesting table is included giving the variations in the price of timber during the nineteenth century in France and Austria. The author also goes into the numerous uses to which timber may be put, and the different substances which are to be got from it by chemical means, from the crude products of distillation to the finest silk. The author further gives a survey of the colonial forests and their products. Then follow two or three chapters dealing with the very important but formerly too frequently disregarded aspect of sylviculture, namely, the influence of the forest on the climate. Very interesting statistics regarding the daily, monthly, and yearly variations of temperature inside and adjacent to the forest are given. Further, the forest influences the humidity of the air. It increases the rainfall. It regulates and preserves the soil-moisture and controls the "flow off" in such a way that disastrous floods and equally pernicious droughts are prevented. The protection forest, and the necessity for its preservation in the high collecting ground, is dealt with in a masterly manner. The forest regions of France, the hygienic influence and æsthetic aspects of the forest, each receives its due share of attention.

In parts ii. and iii. we have a historical account of the forests of France from the very earliest time. Forest administration in all its branches, together with the equipment and training for the State forest service, are fully treated. Part iv., which concludes this volume, contains a vast amount of statistics concerning the present forests and forest regions of France.

The author has evidently spared no pains to make this volume as complete as possible in every way, and it cannot fail to be of great service to those for whom it is written.

Physiologie des Menschen. By Dr. L. Luciani. German Edition by Dr. S. Baglioni and Dr. H. Winterstein. Part v. Pp. 161–320. (Jena: G. Fischer.) Price 4 marks.

THE fifth part of Dr. Luciani's text-book of physiology deals with the mechanical and chemical phenomena of digestion in the alimentary canal, with the absorption and storage of the food-stuffs, and with the excretory functions of the intestinal tract.

The first chapter gives an excellent account of the gastric movements, and of the nerve mechanism controlling them. The second chapter deals with the digestion of the various food materials by means of the pancreatic and intestinal juices, and of the bile. An exceptionally full *résumé* is given of the results following upon removal of extensive portions of the small intestine in animals and in man. The products and probable significance of bacterial digestion are also fully described and discussed.

The account of the peristaltic movements of the intestines and of the nerve mechanism controlling them is well brought up to date, giving briefly the results of the most recent researches in this field.

The final chapter treats of absorption in the stomach and intestines. The channels and mechanism of absorption of different food-stuffs—carbohydrates, fats, and proteids—are fully described. A very interesting epitome is given of the synthesis of the products of proteolysis and lipolysis by means of the intestinal epithelium. The theories with regard to the formation and fate of glycogen in the liver and muscles are critically reviewed. A brief account is also given of the various forms of pathological and experimental diabetes.

The fifth part of the work well maintains the high standard for accuracy and clearness set by its predecessors. J. A. MILROY.

Seta Artificiale. By G. B. Baccioni. Pp. 231. (Milan: Ulrico Hoepli, 1906.) Price L3.50.

THIS is an interesting account of "artificial silk" or "lustra cellulose," an industry which has now assumed serious proportions; in fact, the present production of these new textile threads may be estimated at not less than six tons per day, chiefly manufactured in France, Germany, and Belgium. In the preface it is stated that a Società Italiana della Seta Artificiale in Pavia is the first organisation to undertake developments in Italy. The technology of the industry is briefly outlined in six chapters (pp. 230), attention being chiefly directed to the systems based upon the spinning of collodion (nitrocellulose). The alternative systems, based upon the Cuprammonium and "Viscose" solutions of cellulose, are also described.

The work is a compilation from various sources in the technical literature of cellulose, and makes no claim to an original treatment of the subject-matter. Its appeal will be chiefly to specialists.

The book is original as to binding, for which a silk fabric is employed—as a covering to the humble "board"—the weft of which is a lustra-cellulose yarn.

Zwölf Vorlesungen über die Natur des Lichtes. By Dr. J. Classen. Pp. x+249; diagrams. (Leipzig: G. J. Göschen, 1905.) Price 4 marks.

THESE lectures consist in a series delivered in the winter of 1904–5 in Hamburg to a popular audience. The theme of the lectures is the development of the wave-theory, culminating in the special form of this theory which postulates the essential identity of luminous and electromagnetic waves. The lectures were illustrated experimentally, and a special feature in connection with them is the care taken in devising experiments of a simple and attractive kind. Although they were delivered to a lay public, it must not be supposed that they are popular in the bad sense. They are infused throughout with the scientific spirit; there is no sacrifice of accuracy on the altar of simplicity. The subject is dealt with in a way which must have proved very welcome to the non-professional listener who had some very elementary knowledge of it and desired to have the fundamental experimental facts brought before him in a consecutive way. Geometric propagation, dispersion of colour, interference and diffraction phenomena, double refraction and polarisation, electric oscillations and their quasi-optical properties, the explanation of the demonstrated relations between electrical conductivity and the optical properties of metals—these, in brief outline, are some of the chief phenomena which are expounded. Each experiment is described with the help of a diagram.

We have little but praise for this somewhat unpretentious volume. We note only that the devices attributed here (as usual) to Lecher and Blondlot are essentially the same as that employed previously by Sir O. Lodge in the investigation in which he was engaged when Hertz published his demonstration of the possibility of producing electromagnetic waves.

A la Poursuite d'une Ombre. By Prof. Moye. Pp. 98. (Montpelier: G. Firmin, 1905.)

IN the seven chapters contained in this volume Prof. Moye gives a popular account of the observations made by the Société astronomique Flammarion de Montpelier, at Alcalà de Chisbert, during the total eclipse of the sun on August 30, 1905. The eclipse party consisted of eleven persons, who made a series of valuable observations of the corona and the chromosphere with portable telescopes, spectroscopes, and cameras, and with the naked eye.

In addition to the account of the actual observations, the author discusses eclipse phenomena in general at some length, and gives the results obtained by previous observers since the commencement of detailed eclipse work. A number of drawings and photographs illustrate his remarks.

To anyone unfamiliar with solar eclipse work who desires to make a general survey of all the associated phenomena, and the methods employed in observing them, the book will afford a useful introduction to the subject, and will give him just an insight into the present theories concerning the different portions of our luminary.

Ueber Vererbungsgesetze. By C. Correns. Pp. 43 (Berlin: Gebrüder Borntraeger, 1905.) Price 1.50 marks.

ALTHOUGH only six years have elapsed since De Vries re-discovered the laws of heredity originally propounded by Gregor Mendel, Abbot of Brünn, in 1866, the subject has received so much attention—and in this country especially valuable work has been carried out—that many accounts of the general principles have been written. Prof. Correns, one of the foremost workers on the subject, publishes in this brochure the substance of a lecture delivered at Meran, dealing almost entirely with the botanical side. The account does not go far beyond Mendel's propositions, but the subject of *cryptomeric* is explained with the help of an excellent coloured plate of flowers of Mirabilis, and the writer refers to Galton's theory and the extent to which characters *mendelise, i.e.* develop according to Mendel's laws.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Diurnal Variation of Ionisation in Closed Vessels.

THE connection between the periodicity in the ionisation in closed vessels and the variation in the intensity of the electric field near the earth's surface suggested by Messrs. Campbell and Wood in NATURE of April 19 (p. 583) may readily be explained on the theory of conduction through gases if we assume that the ionisation is caused by radiation from extra-terrestrial sources.

The view of the origin of the earth's field which appears to be in closest agreement with the facts is that it arises in rainy regions on account of the negatively charged rain conveying its charge to the earth, which thus becomes negatively charged. This leaves a high positive potential in the atmosphere immediately above the rainy region which very rapidly distributes itself over the earth's surface by means of discharges in the upper regions of the atmosphere where the pressure is low enough for ionisation by collisions to occur. Owing to the high conductivity of the upper regions of the atmosphere, therefore, the potential will differ only to a relatively slight extent over different regions of the earth's surface; most of the fall of potential between the positive charge over the rainy region and any point of the earth's surface will occur in the badly conducting layer of air at a high pressure, which is comparatively close to the earth's surface.

The above theory is due to Mr. C. T. R. Wilson, with whom I have recently discussed the matter. The explanation of the connection between the earth's field and the ionisation in closed vessels which follows might be made to fit other views of the nature of the earth's field, but I have selected Mr. Wilson's, as it appears to be the most probable.

The distribution of the earth's field, then, reduces itself to a case very similar to that between two plane electrodes immersed in a gas and maintained at a constant difference of potential. Consider what happens if we increase the ionisation near one electrode to a greater extent than that near the other. The potential gradient will become smaller where the ionisation is greatest, and conversely. In the case of the earth the ionising rays presumably come from extra-terrestrial sources, and will be absorbed to some extent by the earth's atmosphere. They will therefore be more intense further away from the earth's surface, and when for some reason or another they increase in intensity they will increase the ionisation at a point some distance from the earth's surface to a greater extent than at a point near to it. From what has been said above, an increase in the ionising rays should therefore produce an increase in the electric intensity close to the surface, and *vice versâ*.

This corresponds exactly with what Messrs. Campbell and Wood have found to be the case; the maxima and minima in the earth's electric field are simultaneous respectively with the maxima and minima in the ionisation in a closed vessel.

It may be of interest to add that Borgmann (*Jurn. Russk. Fisik. Chimičesk. Obščestva* [physical part], xxxvii., No. 4, pp. 77–98, 1905) has also recorded a minimum at about 3 p.m. in the ionisation in a closed vessel. The fact that the time is nearly the same at Cambridge and St. Petersburg seems to indicate that the ionisation is caused by radiation coming from the sun. The fact that the daily variations in the earth's field are conditioned by the sun has already been remarked by meteorologists (*cf.* Arrhenius, "Kosmische Physik," ii., p. 890).

I wish to point out finally that the above explanation of the changes in the earth's field does not depend essentially on radiation coming from extra-terrestrial sources. Any cause which simultaneously increased the penetrating radiation near the earth and the ionisation further away from it would work in the same way.

O. W. RICHARDSON.

Trinity College, Cambridge, April 22.

The New Spot on Jupiter.

THE recent outbreak of dark material in the north equatorial belt and north tropical zone of Jupiter has further intensified, and forms a very prominent and striking feature in the region north-following the red spot. The slanting belt, alluded to in my letter published in last week's NATURE (p. 584), appears to be rapidly extending in a longitudinal direction, and the large dark oval spot on its following side has been several times re-observed here. Transits were obtained as under:—

	h. m.	Longitude
April 15	6 8	75·2
20	5 22	77 5
22	7 2	77·7

The rate of motion appears, therefore, to conform very nearly with that of the red spot and of system ii. of Crommelin's ephemerides (9h. 55m. 40·6s.). On April 20 the north tropical spot was very distinctly seen nearly two hours before sunset, and the transit obtained on that date was regarded as accurate.

The preceding side of the slant-belt is moving much faster than the north tropical spot, and it is highly probable that in a few weeks a new and conspicuous belt will have formed and entwined itself completely round the planet. In this phenomenon we have a repetition of that observed in the spring of 1860 (see Monthly Notices R.A.S., April, 1860, and December, 1898, vols. xx., p. 244, and lix., p. 76).

W. F. DENNING.

Bristol, April 23.

Utilisation of Nitrogen in Air by Plants.

YOUR reviewer (p. 531) of the above work has, like others, failed to furnish any proof against my theory of the fixation of free nitrogen by plants. He desiderates direct chemical proof of the increase of nitrogen in the plant, beyond the nitrogen that is provided by the seed and the soil. Those acquainted with agricultural chemistry know the difficulty of directly determining a slight increase in the quantity of nitrogen, in the circumstance of the comparatively large quantity of nitrogen in the soil necessary to produce a vigorous plant, and they will understand how difficult it is to produce such proof; with the greater information now available, however, it may now be forthcoming. But for this difficulty, the fixation of nitrogen would have been found out long ago.

The experiments at Rothamsted conducted by Lawes and Gilbert are identified with the subject of nitrogen. The idea of the inability of plants to fix free nitrogen is largely based on their experiments. As mentioned in a book written by the recently appointed director at Rothamsted—Mr. A. D. Hall—it occupied their minds "from the very beginning of their experiments until the end." It was their "dominant idea." I may therefore refer to experiments carried out there which show that Lawes and Gilbert themselves found (as many others have done) an increase in nitrogen in growing crops, the source of which could only be ascribed to the atmosphere; thus (see p. 10), "As a result of three years' cropping with barley and clover, and then with clover only, an average amount of 319·5 lb. of nitrogen was removed, yet the soil contained, on analysis at the end of the experiment, 2832 lb. of nitrogen per acre in the top 9 inches, or a gain of 175 lb per acre in the three years, making a total, with the crop removed, of nearly 500 lb. of nitrogen per acre to be accounted for." This was a troublesome fact. It was sought to be explained by the tubercles on legumes, but that an increase was got without legumes is shown by another set of experiments (see p. 8):—"the various crops were grown continuously with mineral manures, but without any supply of combined nitrogen; the following average amounts of nitrogen per acre were taken away:—

			lb.
"Wheat	24 years		22·1
Barley	24 ,,		22·4
Root Crops	30 ,,		16·4
Beans	24 ,,	of which two fallow	45·5
Clover	22 ,,	6 crops only	39·8"

Here again was an increase, and one which legume tubercles could not be brought in to explain. It was only when Lawes and Gilbert, trying to get chemical evidence, grew feeble, unnatural plants under unnatural conditions that they failed to get a similar increase of nitrogen. On this ground alone they supported the theory of the inability of the plant to draw nitrogen from air, and thus supported themselves in the notorious controversy with Liebig, the distinguished German who has done more for agriculture than any other man of science, and who, by the way, denounced the Rothamsted experiments in no measured terms (see the "Natural Laws of Husbandry," pp. 157 and 298).

Obviously, therefore, to show that plants fix free nitrogen is to undermine the work with which Rothamsted is chiefly identified.

Your readers will understand the value of the critique when they know that the initials under it are those of the director at Rothamsted. THOS. JAMIESON.

Glasterberry, Milltimber, April 10.

I AM glad to see that Mr. Jamieson does recognise the necessity of some proof of his assertion that nitrogen has been fixed by the plants he has been examining; he now says that "it may now be forthcoming." When Mr. Jamieson's "may" has been converted into "is," chemists and botanists may begin to consider his speculations as to how the process is effected. For let us bear clearly in mind that Mr. Jamieson's theories only deal with the question of *how* the nitrogen is fixed; that it is fixed at all he takes for granted.

But what an unlucky series of experiments to enforce his argument has Mr. Jamieson selected from Rothamsted. He quotes three non-leguminous crops, wheat, barley, and roots, which when grown continuously on the same land for a period of twenty-four to thirty years have removed on the average 16 lb. to 22 lb. of nitrogen per acre per annum. But at the beginning of the experiments the soil was estimated to contain about 3000 lb. per acre of combined nitrogen, *i.e.* five times as much as the thirty years' cropping has removed. Furthermore, analyses have been made and published which show that the soil has lost nitrogen during this period; the average loss on the unmanured wheat plot from 1865 to 1893 was 10 lb. per acre, which if added to the 5 lb. per acre of combined nitrogen brought down by the rain pretty well accounts for the 19 lb. per acre removed in the crop. Knowing as we do that there are great reserves of nitrogen in the soil, and that they slowly become available for the plant, there is no reason to suspect that these non-leguminous plants have needed to take any nitrogen from the air to yield the crops that are recorded.

Then Mr. Jamieson quotes the output of nitrogen from two leguminous crops, clover and beans, and it is just about double that of the non-leguminous crops; very much more than double, in fact, if calculated on the number of crops actually obtained, and not spread over an average of years. Yet Mr. Jamieson goes on to say that the "legume tubercles" cannot be brought in to explain this; when the only crops yielding anything like an average amount of nitrogen are the two, beans and clover, which by accepted theories obtain nitrogen from the air by means of the bacteria in the "tubercles" on their roots. Most people regard these experiments as a very sound piece of evidence for the fixation of nitrogen by leguminous crops alone.

Let us consider these results from another point of view; the wheat crop without nitrogen, but with phosphoric acid and potash, at Rothamsted averages about fifteen bushels per acre, barley about twenty bushels per acre, the root-crops (mangels) about 5·4 tons per acre; this is the sort of level that is reached when the crop has to rely upon the air and the original stock of nitrogen in the soil. Is Mr. Jamieson proposing to recommend farmers to grow crops of this size, for that is what they must come to when they have only the air to draw upon for their nitrogenous food?

In his concluding paragraph Mr. Jamieson appears to suggest that Lawes and Gilbert ran the Rothamsted experiments as a sort of conspiracy to disguise the truth in favour of a prepossession of their own, and that after their death the body of scientific men who constitute the committee of management engaged their present director to continue the traditional fraud; this is a "theory" which, like others of Mr. Jamieson's, must require a robust confidence in the credulity of his disciples. A. D. H.

A Horizontal Rainbow.

I SHALL be much obliged if a reader of NATURE will kindly give me an explanation of the following:—

I was on Loch Lomond yesterday, a perfectly still, cloudless day, with haze as from east wind over the mountains. There had been hoar-frost in the morning. About 10.15, from the deck on the steamer at Balloch, I observed a broad patch of strong prismatic colours on the absolutely calm surface of the loch about half a mile from the pier, my back being turned to the sun. I watched this patch with interest, and, as the steamer approached it, it gradually lessened and almost disappeared; but in its place a rainbow, faint but distinct, lay horizontally on the surface of the water, one end resting beside the bow of the steamer and the arc curving for perhaps 150 yards ahead, the sun still being behind me. I never saw anything of this kind before, and was much interested. The loch was absolutely calm, reflections of sea-gulls, &c., being perfect.

The only explanation I can think of is that, after the hoar-frost and possible sea-fog of the earlier morning, there was just a film of fog left undisturbed on the calm surface of the water, sufficient to break up the rays of the sun into their component parts. W. R. M. CHURCH.

Western Club, Glasgow, April 12.

THE SAN FRANCISCO EARTHQUAKE OF APRIL 18.

IN the immediate presence of a great catastrophe, in which hundreds of lives have been lost, and San Francisco, the "Queen of the Pacific," has been almost entirely destroyed, it is not to be expected that details of much scientific value should be recorded. All that is here possible is to describe briefly the course of events, to trace in rough outline their connection with former shocks and with the geological history of the district, and to refer to the unfelt earth-waves registered at distant observatories.

NATURE AND EFFECTS OF THE EARTHQUAKE.

Though the coast of California from San Francisco to Los Angeles is one of the chief seismic regions of the globe, the first and greatest shock was heralded by no warning tremors or earth-sounds. It occurred at 5.13 a.m. (that is, 1.13 p.m. Greenwich mean time), perhaps, as the seismographic evidence would imply, a few minutes earlier. As in all tectonic earthquakes of the first magnitude, the duration of the shock was considerable, not less than two or three minutes, and it was in this time that the chief part of the destruction, so far as it was directly due to the earthquake, was accomplished. Five minutes later another and less violent shock was felt, and, in the midst of almost continuous tremors, a third prominent shock took place at 8.15 a.m., and others shortly before 10 a.m., and about 1.30 and 7 p.m. None of these seems to have been registered in European observatories, but they sufficed to throw down walls already damaged. Soon after the first shock fires broke out in several parts of the city, and spread rapidly, the water-mains having been injured. Attempts, on the whole successful, were made to limit their extension by blowing up passages through the crowded parts, with the result that about one-quarter of the city may be ultimately saved.

Like Charleston, which was so seriously damaged by an earthquake twenty years ago, San Francisco is

built upon a peninsula; and the effects of the two shocks, as revealed by the distribution of the damage, were very similar. Although the whole of both cities suffered severely, the chief destruction was confined to houses built on low-lying "made" land. In San Francisco this land is occupied by business houses and warehouses, and, in the southern part, by cheap tenements and poorly-built lodging-houses. At 5 a.m. most persons were in bed, and thus there was little loss of life in the business district, and much in that covered by the tenements. The better-class residential district, situated on the hills, escaped with comparative impunity, so far as the earthquakes were concerned, though the fires afterwards spread to that quarter.

That San Francisco was situated within or close to the epicentral area is shown by the continuous after-shocks, and by the effects of the shock. Observers in the open air state that the streets could be seen to bulge and wave as if about to crack open. Three miles of railway have sunk out of sight between Suisan and Benetia; several railway tracks have been destroyed for scores of miles; and on the harbour-front the earth appears to have sunk from six to eight inches. Great cracks were formed in the streets, and these cracks were twisted into all shapes. The houses, before they were destroyed by fire, were also seen to be out of alignment.

Outside San Francisco many towns are known to have suffered severely, especially San José, Santa Cruz and Santa Rosa; others less seriously, from Mendocino on the north to Monterey on the south. With our present information (and the absence of news from neighbouring places, and especially from the Lick Observatory, is disquieting), the meizoseismal area is a band extending along the coast and parallel to the Coast Range, about three hundred miles in length and not more than fifty miles in width. The extent of the disturbed area will remain unknown until inquiries have been made, but it is curious how few details on the subject have yet been published. Los Angeles (only 350 miles S.E. of San Francisco) does not seem to have been affected to any extent by the principal earthquake, though the shock was felt severely throughout the whole of the neighbouring State of Nevada, and there are vague reports of more distant observations.

Position of the Epicentre and Seismic Sea-Waves.

If the line drawn so as to bound the known area of destruction be even approximately correct, there can be no doubt that the epicentre was submarine and situated some little distance from the coast. The fact that the shock was felt at San Francisco two or three minutes after the epicentral time implied by the seismic records is also in favour of this conclusion. The chief difficulty in accepting it lies in the absence of any very great sea-waves. Much of San Francisco is only about twelve feet above high-water mark, and would have been submerged by any considerable wave. There seems, however, to have been some disturbance of the sea. Many vessels, it is said, were washed ashore with each disturbance, and washed out again by the receding waters. There are also unconfirmed reports that Terminal Island, a seaside resort about twenty miles from San Francisco, has been destroyed by a sea-wave, and that other places on the Californian coast have also been swept away. At present it is probable that the first decisive evidence of sea-waves, if any existed, will come to us from the eastern shores of Japan, which would be reached by them in about ten and a half hours after the earthquake.

Geological Relations of the Earthquake.

The earthquakes of California have been studied for some years by Messrs. Holden and Perrine, of the Lick Observatory, and the geology of the State is being revealed through the labours of Messrs. Russell, Diller and Lawson; while an admirable summary of their relations was recently presented in M. de Montessus' valuable work on "Géographie séismologique" (pp. 404–412). Between the Rocky Mountains and the Pacific are the parallel chains of the Sierra Nevada and the Coast Range. Among the Rocky Mountains earthquakes are few and slight; on the eastern slopes of the Sierra Nevada they are more frequent, and sometimes, as in the Owen's Valley earthquake of 1872, of considerable severity. The western portion of the Sierra Nevada, the Cascade Range, is remarkably free from earthquakes, though it is worth noting by those who see an intimate relation between volcanic and seismic actions that it contains the recently extinct cones of Shasta, Mount Hood and Mount Rainier. Again, the Coast Range, and especially the districts surrounding San Francisco and Los Angeles, is one of the great seismic regions of the globe. Lastly, to the west of California the sea-bed deepens rapidly, the contour of 4000 metres lying only a short distance from the land, and from this region many of the strong Californian earthquakes are known to proceed.

Recent studies have established a close connection between these earthquakes and the geological structure of the district. Whether the earthquakes take place under the Coast Range or beneath the adjoining ocean, the longer axes of the isoseismal lines are either parallel or perpendicular to the sub-oceanic contour-lines, the crust-folds of the Coast Range and the long lines of fault of the Pacific seaboard. It is difficult to resist the conclusion that in the western United States we are presented with mountains in four successive stages of growth. In the Rockies we have ranges so ancient that they have almost ceased to grow; in the Sierra Nevada to the west another which is approaching old age; the Coast Ranges are in the stage of youthful, vigorous growth, with the possibility of a long and active life before them; while, still farther to the west and not yet risen above the ocean, there seems to lie an embryonic range, of which the San Francisco and other earthquakes are the birth-throes.

The Unfelt Earth-Waves.

In all parts of the world delicate seismographs soon afterwards recorded the occurrence of a violent earthquake. The first waves reached Victoria (B.C.) at 1.16 p.m.; at Washington the movement was so strong that the pen passed off the recording sheet. In a quarter of an hour the seismographs of Great Britain took up the tale, large disturbances being recorded at Shide, Bidston, and Edinburgh; at Birmingham the pointer of the Omori horizontal pendulum swept three times off the drum. Passing over to the Continent, they set to work the instruments at Berlin, Heidelberg, Vienna, Laibach, Turin, Rome, and many other places. The pendulums at Florence shared the fate of those at Washington and Birmingham. The seismograph at Cape Town also registered the movement, while those in Japan were disturbed by the waves proceeding in the opposite direction across the Pacific. Only the scantiest details are as yet made known, but, if we may judge from the diagram at Birmingham, the complete series of records will be one of great interest and value.

The first series of preliminary tremors reached Birmingham at 1h. 25m. 3s. p.m. (G.M.T.); they were

small in amplitude and had an average period of 6·4 seconds. At 1h. 35m. 7s. they were followed by the second series of preliminary tremors, much larger in amplitude and with an average period of 11·4 seconds. These tremors, as is now well known, traverse the body of the earth with velocities of about 10 or 11 and 5 km. per second respectively. At 1h. 45m. 13s. began the principal portion of the movement, consisting of undulations which travel over the surface with a nearly uniform velocity of 3·3 or 3·4 km. per second. In the initial phase of this portion the undulations had an average period of 44·1 seconds; in the slow-period phase (which began at 1h. 50m. 22s.) of 25·2 seconds, and in the succeeding quick-period phase of 16·2 seconds. Unfortunately, this portion of the record is incomplete, for the pointer of the pendulum swept off and on the drum three times, several waves being thus lost, and the initial epoch of the quick-period phase cannot be determined. The end-portion of the disturbance began at 2h. 1m. 4s., and consisted of a long series of unusually clear and regular waves with an average period of 15·0 seconds. The duration of this portion is uncertain, for these waves were reinforced at 3h. 28m. 38s. by the undulations of the principal portion which travelled through the antipodes along the major arc joining San Francisco and Birmingham. At 3h. 56m. 57s., however, the trace becomes nearly steady, but a careful examination reveals another series of long, low undulations from 4h. 58m. 32s. to 5h. 6m. 34s., which represent the return of the first series of surface-undulations after they had completed the tour of the globe and travelled once more as far as Birmingham. The interval between the first and third passages of these waves is 3h. 13m. 19s., and corresponds to a mean velocity of 3·36 km. per second.

MAGNITUDE OF THE SAN FRANCISCO EARTHQUAKE.

The mere fact that the earth-waves should disturb a seismograph after travelling 30,000 miles is sufficient evidence to show that the earthquake belongs to the very front rank. If we might estimate the intensity of a shock by the maximum range of movement at Birmingham, we should have to regard the San Francisco earthquake as much stronger than the Indian earthquake of April 4, 1905, but as inferior to the remarkable Central Asian earthquakes of July 9 and 23, 1905. The period of the larger waves approaches, however, so closely to that of the pendulums themselves that it by no means follows that the range and epoch of the maximum displacement of the instruments correspond with those of the earth's crust. Nor can we infer much from the extent of the destruction of the lofty, badly-founded houses of San Francisco. If the Colchester earthquake of 1884 had originated beneath the city and west-end of London instead of beneath the villages of Peldon and Rowhedge in Essex, the damage would have been considerable, and the earthquake would have held a higher place in our estimation. When, however, we consider the great area covered by the injured towns in California, the displacement of the superficial soil, the crumpling of the railway tracks, and the widespread registration of the unfelt waves, it is clear that we must give to the San Francisco earthquake a place inferior, no doubt, to the Lisbon earthquake of 1755 and the Indian earthquake of 1897, but probably one in the same rank as the Neapolitan earthquake of 1857, the Japanese earthquake of 1891, and the Indian earthquake of 1905.

C. DAVISON.

THE LIFE OF THE AUSTRALIAN BLACKS.[1]

BOTH for the anthropologist, who wants well-sifted and trustworthy material, and for the ordinary reader who would like to know something about the life of the native Australian, this is a most useful book. In fact, for the latter purpose it may be said to stand entirely alone. There is no other work on the Australians which gives anything like so good a general view; it is clear of superfluous technicalities, eminently readable, and written with so much sympathy that we cease to be surprised at the success of the writer in getting at such secret matters as male initiation ceremonies and beliefs about Byamee, all of which are strictly forbidden lore to the Euahlayi woman. Mr. Lang's introduction explains the bearing of the book on current controversies.

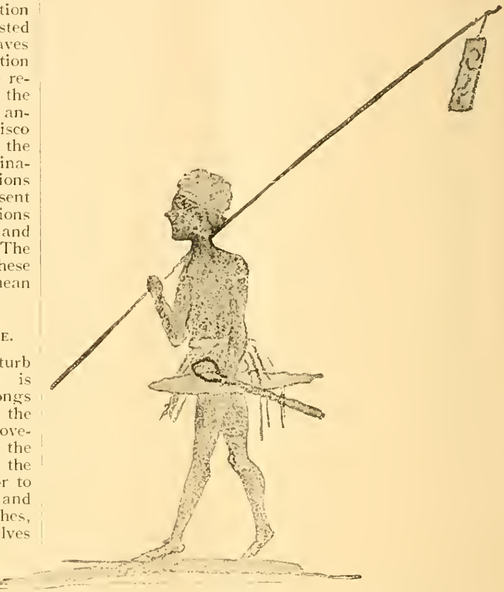


FIG. 1.—A native carrying a message-stick. From "The Euahlayi Tribe."

Besides these two important subjects, Mrs. Parker has much to tell us about the social organisation, magicians and their initiation, a witch woman whose feats are distinctly mystifying, the life of children of both sexes up to and including the initiation ceremonies, burial customs, dress, amusements, the provision of food, and mythology; and on many points we learn something which throws light on previous knowledge. Although we hear nothing of the so-called sex-totem among the Euahlayi, they hold that the male children are made by a lizard, the female by the moon, who is sometimes assisted by the crow. This looks like the raw material of the sex-totem. It

[1] "The Euahlayi Tribe, a Study of Aboriginal Life in Australia." By K. Langloh Parker; with an Introduction by Andrew Lang. Pp. xxvii+156; with 6 illustrations by a native artist. (London: A. Constable and Co., Ltd., 1905.) Price 7s. 6d. net.

may be noted that the lizard is one of the forms of the sex-totem in South Australia. In connection with children, it is interesting to note that we have in the Euahlayi a variant of the Arunta belief recorded by Strehlow, which has also a close connection with the belief of the northern Arunta visited by Spencer and Gillen.

An important subject, on which little information was previously available, is that of the *yunbeai* or individual totem, which is usually confined to medicine men, but among the Euahlayi is held to be granted to their special favourites. More important still is the information about Byamee. Unless Mrs. Parker's evidence can be impeached on the ground of European influence, it will henceforth be impossible to deny that the Australians have gods and a religion. We learn from this work that prayers are offered to Byamee both at the Bora and at the funerals of men.

Mrs. Parker alludes to the boomerang, and provides mathematicians with another problem in the shape of the performances of the *boodthul*, a miniature club which travels further if it is thrown through the top of a bush than if it has an unimpeded flight. The book contains six illustrations by a native artist. Mrs. Parker does not mention them, but she has informed the present writer that the artist had no European training. It may, however, be surmised that he had seen European pictures. N. W. T.

BORIC ACID AS A FOOD PRESERVATIVE.[1]

THE report of the English departmental committee on the use of preservatives in foods contains voluminous evidence on the harmful nature of most of the antiseptics employed in commerce. It was issued in 1901, and among its recommendations one finds that the use of any preservative in milk should be constituted a punishable offence. It, however, makes an exception in the case of butter and cream, which are substances taken in relatively small amounts, and allowed 0.5 per cent. of boric acid in the former, and 0.25 per cent. in the latter case.

Those who have had the time to read the evidence will be struck with the almost complete unanimity of the medical witnesses on the harmful effects produced by boric acid and its compounds. Unfortunately there will always be some who disagree with the majority, and it is particularly unfortunate from the point of view of the public welfare that one of these is Dr. Oscar Liebreich, whose opinion is on most subjects entitled to careful consideration and respect. The special pleading on behalf of boric acid and borax contained in Dr. Liebreich's former publications are repeated in the pamphlet just issued, and we fear that the useful work of those who are trying to prevent adulteration, and protect the public from those tradesmen who cover their misdeeds and want of cleanliness by the employment of antiseptics dangerous to health, will be seriously impeded thereby.

The question has also become an acute one in America, and the United States Department of Agriculture appointed Dr. Wiley, their principal chemist, to investigate the matter on a large scale by experiments on human beings, over a long period. Dr. Wiley's report was most unfavourable to the use of these preservatives; the ill-health set up in the subjects of his experiments, and the alterations in bodily metabolism to which this was due, are described in detail, and furnish systematic evidence on the subject which confirms what was known from clinical experience, and to those who had experimented previously on animals. To the unprejudiced observer Dr. Wiley's report settled the matter once and for all.

The special object of Dr. Liebreich's new brochure is to criticise some details in Dr. Wiley's work. This is always an easy thing to do when the subjects of an experiment are numerous, and in the human subject in particular it is often difficult to obtain precise details. Some of these, on account of the ill-health set up by the drug, had to abandon the continuation of the observations. This obviously reduces the number of observations, but at the same time is in itself a striking piece of evidence against the continued use of borax and boric acid. Dr. Liebreich does not dispute the ill-health of Dr. Wiley's willing subjects, but he is driven to attribute this to other causes, like inefficient hygienic surroundings. He does not dispute the loss of body weight, but says this is not by any means always injurious.

Those interested in this most important question should of course read both sides, and one sincerely trusts that in this instance the weight of a great name will not be allowed to overbalance the all but universal testimony of others to the contrary.

[1] "Third Treatise on the Effects of Borax and Boric Acid on the Human System." By Dr. Oscar Liebreich. Pp. vii+70. (London: J. and A. Churchill, 1906.) Price 5s. net.

PROF. W. F. R. WELDON, F.R.S.

THE 'seventies of last century may be said to have witnessed the renaissance of biological studies in Cambridge. It was in the year 1870, if we mistake not, that Michael Foster, at the invitation of Trinity College, became prælector in physiology and founded the great school for which the university has since been famous. Of his pupils the greatest was F. M. Balfour. He very soon became the centre of a new system which was thrown off, so to speak, from the main body, and rapidly acquired form and influence.

Weldon was one of the most distinguished products of the zoological school which was in this way established. He was the son of Mr. Walter Weldon, F.R.S., the distinguished chemist, and was educated at King's College, London. He entered at St. John's College, Cambridge, in 1878, of which foundation he became first a scholar and in 1884 a fellow. After taking his degree in 1881 he at once threw himself with characteristic vigour and disinterestedness into zoological teaching and research. He became demonstrator in comparative anatomy in 1884, and held the office for one year. In 1885 he was appointed to the newly-established lectureship on the morphology of the invertebrata, which office he held until he left Cambridge in 1891. As a lecturer Weldon is not likely to be forgotten by those who heard him. He was remarkable for the ease and mastery with which he handled his subject, and for the earnestness and clearness of his teaching. It was impossible to sit inert under him; he had the gift of compelling attention.

Weldon's early researches were mainly concerned with morphological problems, the study of which had been so strongly stimulated by the work of Darwin. In the 'sixties, 'seventies and early 'eighties of last century the hope existed that it would be possible by minute morphological study actually to trace the pedigrees of existing organisms and to get some comprehension of the wonders and complexities of animal structure. In the 'eighties, however, with the progress of experience it began to be obvious that these hopes could not be realised, that the problem could not be solved by morphology, and that we must turn to other sources if we wanted to progress in ideas. Weldon was soon touched by the scepticism which thus arose, and cast about in the latter part of his time at Cambridge for new methods. These he saw must come in part at least from an exact study of variation, and

his work was henceforth mainly directed to that subject. He spent his vacations at the laboratory of the Marine Biological Association at Plymouth and in the Zoological Laboratory at Naples, and devoted himself to laborious and systematic measurements of the parts of various marine organisms. These researches were continued with increased vigour at University College, London, where in 1891 he succeeded Prof. Ray Lankester as Jodrell professor of zoology. Here he entirely fulfilled the expectations which had been formed of him at Cambridge. Effective and enthusiastic as a teacher, he soon gathered around him a body of young workers whom he inspired by his own intensive fire.

During his career at University College he played a leading part in initiating the changes which, after some set-backs, resulted in the recent reorganisation of the University of London as a teaching body. In the completion of this most important work he was debarred from active participation, for in 1899 he was appointed the Linacre professor of comparative anatomy in the University of Oxford.

At Oxford he devoted himself with signal success to the duties of his professorship, paying special attention to the subject of variation. He again formed the centre of an active school of research, and founded in conjunction with Prof. Karl Pearson the journal *Biometrika* to advance the subject which he had so much at heart. Of his biometric work much might be said, but this must suffice. He was the one English biologist who actually realised what the whole attempt to give quantitative exactness to biological concepts really means; and he was the first to calculate organic coefficients of correlation and to suggest their important bearing on evolution.

Weldon held the chair at Oxford until his death on Good Friday last, after an illness of little more than twenty-four hours. He was born in 1860, and was therefore a comparatively young man when he died. He had about reached the stage of life when the germinating processes of the brain have attained their maximum and the mind begins to take stock of its ideas and to seek for means of coordinating them and of so bringing them before the world. He had several works on hand, all of which are unfinished. The most important, perhaps, is that in which he hoped to set down the conclusions he had reached on the great subject of the origin and the handing on by heredity of the properties of organisms.

His work, therefore, is not finished, but of whom can it be said that his work is finished? He has at least carved out the steps by which others will mount. He has sown the seed. It is for us who remain and for those who come after us to reap the fruits of his labours.

He was essentially a good man, and happiness was his portion in this life. Blessed in his domestic circumstances, and in holding one of the most distinguished positions the zoological world has to offer; in the possession of good health, of considerable bodily strength and activity, of indomitable energy, of a quick and penetrating intellect which rendered all intellectual effort pleasurable, of acute literary and artistic instincts, of a simple, honest, and lovable nature which endeared him to all who came in contact with him, he had everything which is necessary for earthly happiness. So amply had nature lavished her gifts upon him that he might well have been counted among her spoilt children. But he was lofty in his aims and strenuous in his life. His early death is a grievous blow to science; to his friends it is an affliction hard to be borne; to those who loved him it can only appear as a cruel and unnecessary calamity; but yet, can we say that he was not happy in his death, as in his life?

> Under the wide and starry sky
> Dig the grave and let me lie,
> Glad did I live and gladly die
> And I laid me down with a will.

PROF. PIERRE CURIE.

M. PIERRE CURIE, co-discoverer with his wife, Mme. Sklodowska Curie, of the element radium, and the investigator of many of its properties, met his death as the result of a street accident in Paris on Thursday, April 19. He was crossing the Place Dauphine when he was knocked down by a cab and fell under a heavy van coming from the opposite direction. The wheels passed over his head, and when taken to the police station life was found to be extinct.

Cut off in the midst of a career of active scientific investigation, in the flower of life and at the height of a unique reputation, brilliantly won and universally acknowledged, his death will be mourned by the whole civilised world. In this country, where the importance of his work and discoveries was early and fully recognised, and where the fame attaching to his name has spread widely, deep sympathy will be felt for Mme. Curie in her tragic bereavement, coupled with a sense of loss that a partnership in science so illustrious and fruitful has been brought to so untimely a close.

Born in Paris on March 15, 1859, Pierre Curie received his early education at the Sorbonne, where he attained the degree of Doctor of Science. He was made professor of physics in the Municipal School of Physics and Chemistry in Paris in 1895, and in 1900 he became professor at the Sorbonne. His earlier researches, extending over the period 1885–1894, included investigations into the phenomenon of piezo-electricity, in conjunction with his brother, J. Curie, the construction and use of electrometers and guard-ring condensers, the magnetic properties of iron, oxygen, and other substances at different temperatures, and the construction of sensitive aperiodic balances.

In 1895 M. Curie married Marie Sklodowska, one of the senior students at the Municipal School, where he was professor, and joined his wife in the new field of research opened up by M. Henri Becquerel's discovery of the radio-activity of uranium and its compounds. From 1898 onwards appeared the remarkable joint publications dealing with the discovery of radium and the investigation of its properties. The great advances made by the two investigators in this field may be traced to the collaboration of a trained physicist and a skilled chemist in a subject which may truly be described as a meeting ground of the two sciences. M. Curie's earlier results on piezo-electricity, and the construction and use of electrometers and condensers were ingeniously applied to the requirements of the new work, and in his hands resulted in a ready and trustworthy method for the electrical measurement of radio-activity being worked out. In the detection and initial stages of the separation of radium and polonium in pitchblende, the method accomplished what in the hands of Bunsen the spectroscope had accomplished in the detection and separation of cæsium and rubidium in the waters of Durkheim. When sufficient radium had been obtained, M. Curie and his pupils investigated the physical properties, while Mme. Curie devoted herself to the more purely chemical problems, the determination of the atomic weight of the new element, and the attempt to separate polonium.

M. Curie's most important contributions to the study

of the nature of the new element comprise the discovery, in conjunction with Mme. Curie, of the so-called induced activity conferred by radium on surrounding objects, and the proof that the penetrating radiations transport negative electricity even after they have been made to pass through a sheet of metal connected to earth. In conjunction with M. Laborde he discovered and measured the spontaneous evolution of heat from radium compounds.

In 1903 the Davy medal was conferred by the Royal Society on M. and Mme. Curie, and they shared with M. Branly the Osiris prize, and with M. Becquerel the Nobel prize for physics. M. Curie was made a member of the Institute of France in 1905. He will be remembered in this country for the lecture on radium, delivered with characteristic modesty and simplicity of manner, at the Royal Institution in 1903. He refused the Cross of the Legion of Honour offered by the French Government, on the ground that he preferred to remain a simple citizen, holding no doubt the view that scientific discovery is its own sufficient reward.

It has been said by a recent writer that there will come a time when men will date the coming in of their kingdom to the day when Curie and Laborde discovered the spontaneous evolution of heat from radium. Certainly no limit can be set to the consequences in the near or distant future which may be expected to flow from the discoveries with which the name of Curie is associated.

Like Röntgen shortly before, Curie emerged at one step from comparative obscurity to universal fame, and what they achieved is still within the horizon of the humblest investigator. Like the soldiers of Napoleon, each of the rank and file of the army of patient investigators carries in his knapsack a marshal's baton. The career of M. Curie illustrates this, and continues as an inspiration and encouragement to others. None have set in motion more pregnant influences. No one stands in less need of the historian to perpetuate his memory. F. S.

NOTES.

In the disastrous earthquake at San Francisco, a detailed description of which is given in another part of the present issue, it is reported that upwards of 1000 persons lost their lives, and that material damage was done to the value of more than sixty million pounds sterling. There seems little reason to doubt that most of these lives and the greater part of the property were lost in the fire which followed the earthquake, and that a little forethought would have prevented, or at least greatly lessened, the awful calamity. Electric mains were broken by the earthquake shock at a time when the current was being supplied, and gas and water mains were shattered. The electric current does not appear to have been stopped at the power stations, and the consequent numerous short circuits which occurred soon inflamed escaping gas and set fire to buildings in many parts of the city. The broken water mains obliterated the water supply, and the only means of checking the fire seems to have been the demolition by dynamite of property in its path. The steel buildings in the city appear to be almost intact. The earthquake did not damage them, and the fire only consumed the woodwork. Despite the rumours which have been in circulation as to damage to universities and observatories in the disturbed area, it is gratifying to know that there is as yet no confirmation of such calamities. Upon inquiry at the Royal Astronomical Society, we learn that no news has been received about any of the Californian observatories. Astronomers are particularly anxious as to the fate of the Lick Observatory, situated as it is very near to the centre of disturbance, and in view of a rumour that has reached a London fire insurance company of serious injury to the observatory. The Solar Observatory at Mount Wilson—near Pasadena, which is ten miles N.N.E. of Los Angeles—is probably too far to the south to have been damaged.

Some changes in the organisation of the Geological Survey of Canada have recently been made by the Premier, Sir Wilfrid Laurier. For more than five years Dr. Robert Bell, F.R.S., has been the acting-director of the Survey, and has managed the business as well as the scientific affairs to the satisfaction of the scientific, mining, and the general public. In this period he has accomplished much valuable work, initiated many useful new features, and raised the standing of the Survey in general estimation. Since the Survey began, sixty-three years ago, about 470 maps have been prepared and issued, and nearly one-third of this number have been published during the past five years, while others are nearly ready. By the change of organisation which has just been instituted, a business administrator has been appointed, while Dr. Bell is given the title of Chief Geologist of the Dominion. Dr. Bell will continue to prepare his reports, maps, and other works, and will have a free hand in geological matters, so that he ought apparently to be congratulated on being relieved of a troublesome and difficult part of his work.

The bi-centenary of the birth of Benjamin Franklin was celebrated by the American Philosophical Society at Philadelphia on April 17–20, in accordance with the programme announced in Nature of March 29 (p. 515). Addresses were read from the universities of Oxford, Cambridge, Glasgow, and Edinburgh, the Paris Academy of Sciences, and many other institutions. A statue of Franklin, presented to the City of Paris by Mr. J. H. Harjes, was to have been dedicated on April 20 at an international festival, in which the French Government had arranged to take part, but the celebrations were postponed in consequence of the catastrophe at San Francisco.

Prof. W. Ostwald has been elected a foreign member of the Danish Academy of Sciences.

Prof. Gabriel Oltramare, who for fifty years held the chair of mathematics at Geneva University, died on April 10, in his ninetieth year.

The death is announced, at sixty-five years of age, of Dr. N. S. Shaler, professor of geology at Harvard University and dean of the Lawrence Scientific School.

The annual meeting of the South African Association for the Advancement of Science will be held at Kimberley on July 9–14, under the presidency of Mr. G. F. Williams.

Dr. Dudley Buxton has been elected chairman of the council of the Selborne Society for the ensuing year, during which the society will attain its majority, having been founded in 1885. The annual *soirée* will be held on May 25, when the president, Lord Avebury, will deliver an address.

A telegram from Sarajevo, Bosnia, states that at 11 a.m. on April 19 a short, sharp earthquake shock was felt there. The shock was undulatory in character, and travelled from west to east. An earthquake shock was felt at Grants Pass, Oregon, at 1.11 a.m. on April 23. The Wellington correspondent of the *Times* reports that both the Eastern

Company's cables between New Zealand and Australia suddenly broke on April 23, as the result, it is presumed, of submarine disturbances. A sharp earthquake shock was felt at San Francisco at 10.30 p.m. on the same date. It lasted about three seconds, and the motion was from east to west.

Dr. V. F. L. Matteucci, director of the Vesuvius Observatory, has issued the following reports:—*April* 18.—A very violent squall blew the plume of smoke which hung over Vesuvius on to the observatory, bearing with it a quantity of dust and asphyxiating gases. The crater, though shrouded in thick mist and rain, seems to be quiet. *April* 20.—The shower of ash has ceased and the cloud of dust has dispersed, leaving visible the crater, which continues to eject, though more calmly, globular masses of vapour containing lesser quantities of dust, which fall on the eastern slopes of the volcano. No further shocks have occurred, only very slight movements being reported by the more sensitive seismographs. *April* 23.—The seismic instruments are very steady. The crater is emitting grey vapour, together with small quantities of dust at intervals.

According to the *Chemiker Zeitung*, the number of patents applied for during 1905 in Germany was 30,085 as against 28,360 in 1904, whilst the number of patents fully taken out was 9600 against 9189. Of the different applications, 22,030 were by Germans, 1769 by Americans, 1410 by Frenchmen, 1264 by Englishmen, 873 from Austria, 707 from Switzerland, 473 from Belgium, 249 from Hungary, 246 from Russia, 230 from Denmark, 188 from Italy, 174 from Sweden, 48 from Norway, &c. The largest number of new patents for the year came under the heading of electrotechnics. During the year 8623 patents expired or for other reasons ceased to be worked, while at the end of the year 32,430 patents remained in force.

From Budapest we learn that the director of the Hungarian Chemical Agricultural Institute has presented a strong petition to the Government urging the complete reorganisation of the institute, which was opened twenty-five years ago by the Minister of Agriculture as a central experimental station for agricultural chemistry. In the first instance it is proposed that no further analyses for private persons be undertaken, as this is not only unfair to the private laboratories, but provides so much work for the institute as to hinder members of the staff from following up any line of scientific research. Great stress is laid upon the advisability of bringing all the experimental stations into intimate union with the Imperial Institute of Hungary. According to the director's proposal, the reorganised institute shall be divided into seven departments, each under the supervision of a head chemist.

The Easter party of naturalists and students at the Liverpool Marine Biology Committee's station at Port Erin, in the Isle of Man, has been larger than usual, and the available accommodation in both hatchery and laboratory has been fully occupied. In addition to senior students from the botanical and zoological departments of the universities of Manchester and Liverpool, the following professional workers have occupied tables in the laboratory:—Dr. H. E. Roaf (bio-chemistry), Mr. J. Pearson, Mr. W. Gunn and Prof. Herdman, and Mr. Chadwick, the curator of the biological station. In the sea-fish hatchery the season has been a good one. Although the first fertilised plaice eggs were obtained from the spawning pond on February 13, only one day earlier than last year, embryos in large numbers appeared comparatively early in the season, and the output of young fish is now about a million in advance of the corresponding date in 1905. Five and three-quarter million plaice eggs have now been obtained from the pond, and nearly three and a half million larvæ have been set free in the Irish Sea. The largest number put out on one day was 470,000, on April 20.

The latest report of the Decimal Association, of which Lord Kelvin is a vice-president, states that it is proposed to open a new Parliamentary campaign to prepare the way for the introduction of a Bill in the House of Commons, on the lines of the Bill which has already passed the House of Lords. The report goes on to point out that advocates of the metric system of weights and measures in the United States of America have been encouraged by the introduction of a Bill in the House of Representatives by Mr. Littauer, which provides for the exclusive use of metric weights and measures in all Government departments. This Bill, as has been recorded already in these columns, is now before a Standing Committee of the House of Representatives, and there is every hope that it may be reported on favourably. The executive committee of the association records in the report its thanks to the Association of Trade Protection Societies for its continued advocacy of the compulsory adoption of metric weights and measures. Since this association represents retail as well as wholesale traders, its support may be taken as a distinct refutation of the assertion that the shopkeepers of the country do not wish to see the adoption of the decimal system of measurement. The report mentions also that the Canadian Government has appointed as lecturer a professor of the University of Toronto to devote a year to the task of explaining the metric weights and measures in all the leading cities from Halifax to Vancouver.

Reports are being received of twilight glows and of the deposition of dust, supposed to be due to the recent eruption of Vesuvius. Prof. Stanislas Meunier has collected on the roof of his house in Paris dust said to be identical with the dust of the eruption of 1872. At Southall, Middlesex, Mr. G. Gibson has also collected dust apparently of similar nature. Dr. F. A. Bather, writing from Wimbledon, informs us that on the evening of April 18 the sunset was strongly reminiscent of the Krakatão glows. It will be interesting to learn whether similar observations have been recorded in other localities. The distribution of the dust would depend chiefly upon the upper air currents, which are usually different from those at the surface, and although the surface winds have recently been from north and north-east, the dust may have been carried to north-west Europe by currents in the upper air.

It is stated in the *Cologne Gazette* that the German Government is making preparations for the issue shortly of weather forecasts for agriculturists. The forecasts will be sent free or at a nominal charge, and the success of the undertaking will be judged from returns of the subsequent weather supplied by the recipients of the information. We think this is a step in the right direction; the experiment has already been made with much success in the United States and elsewhere. Prof. Willis Moore, *e.g.*, in an article in the *National Geographic Magazine* for June, 1905, says:—"No large grower of fruits or vegetables is content to be excluded from the receipt of the frost forecasts." During the hay and corn harvest (June–September) special forecasts have been, for many years, issued to farmers in this country by the Meteorological

Office. The only charge now made is for the actual cost of the telegrams, and the success of the work is judged, as proposed in the German scheme, by the returns made by the recipients themselves. From the last published annual report (1904–5) we see that the total and partial success of the forecasts amounted to 92 per cent. for the country generally, and that 58 per cent. were completely successful.

The Bulletin of the Italian Meteorological Society is now issued in two-monthly parts, and includes original contributions and monthly results of observations at a considerable number of stations. The issue for February-March contains an interesting account of the ascents of two unmanned balloons in August last, near Treviso, Venice, in both of which readings were obtained at altitudes exceeding 10,000 metres. The first important inversion of temperature, amounting to 6° C., was experienced between 10,000 metres and 10,385 metres, on August 4, notwithstanding the fact that a few hours previously a very violent thunderstorm occurred at the station. The second ascent was made on August 30, at the time of the solar eclipse; the inversion of temperature was not so marked as in the previous case, but amounted to 3° C. between the heights of 18,000 metres and 20,000 metres. The exact altitude of the inversion during this ascent is somewhat uncertain, as the barometric trace was partially obliterated by the peasants who picked up the records. Thunderstorms were also prevalent about twelve hours prior to the time of this ascent. The discovery of such inversions of temperature is known to be one of the most interesting results connected with the recent explorations of the upper air.

To vol. xxvi., part iv., of Notes from the Leyden Museum, Dr. H. W. van der Weele contributes three papers on Malay Neuroptera, the most important of these dealing with the representatives of the family Sialidæ. Among other notes, Dr. J. G. de Man discusses and redescribes certain Malay crustaceans of the genus Palæmon, while Dr. R. Horst describes a parasitic copepod crustacean of the genus Penella infesting a large fish from the Moluccas.

A hand-list of Philippine birds has been drawn up by Messrs. R. C. McGregor and D. C. Worcester, and published at Manila by the Bureau of Government Laboratories. A slip inserted within the cover announces that the publication of the Bulletins of the Bureau has been discontinued, and that in their place will be issued a new serial, the *Philippine Journal of Science*, while the Bureau itself becomes the Bureau of Science of the Philippine Islands.

The January issue (vol. x., part i.) of the Transactions of the Leicester Literary and Philosophical Society contains a report of the president's address at the annual meeting in October last, in which attention is directed to the decadence of artistic feeling and good taste in the design and execution of architectural and kindred objects in and around Leicester. The contents include a paper by Mr. J. R. Plant on the geological history of molluscs, and a second, by Mr. H. Donisthorne, on Isle of Wight beetles.

No. 1442 of the Proceedings of the U.S. National Museum is devoted to notices of the type specimens of Ordovician and Silurian Bryozoa collected and described by Mr. U. P. James. These fossils, which came from the Cincinnati group, are mostly in the Walker Museum at Chicago, although some are preserved at Washington. According to the author of the paper before us, Mr. R. S. Bassler, the original determinations were for the most part erroneous. Descriptions of new South American moths, by Mr. W. Schaus, of Twickenham, form the subject of No. 1444 of the same serial.

The life-history of the North American cave-salamander, *Spelerpes maculicaudus*, by Messrs. A. M. Banta and W. L. McAtee, forms the subject of No. 1443 of the Proceedings of the U.S. National Museum (vol. xxx., p. 67). This handsome salamander appears to be confined to the Mississippi valley, where, although commonly found in caves, it may occasionally be met with in woods. When in caves, it is generally to be found at no great distance from the entrance, usually but little beyond the twilight zone. For breeding purposes, however, these creatures penetrate deeper into the recesses of the caves, where the larvæ are produced; such full-grown larvæ as are met with in the open country having probably been washed out by freshets. Within caves the adult salamanders are usually to be found in crevices or upon rock-shelves.

The March number of the *Museums Journal* contains an account, by Dr. W. E. Hoyle, of the new zoological institute at Breslau; while Prof. J. T. Wilson's paper on the Australian Museum, Sydney, which was read last year at the Worcester conference, is printed in full. In another article it is stated that Mr. E. Lovett, of Croydon, has formed a large collection of manufactured objects which he is desirous of using as the basis of a "Folk Museum." A schedule is given of the collection of appliances and allied objects used by primitive man, arranged to illustrate the evolution of idea, form, and design, with the amount of superficies required for their proper display in a museum.

In parts i. and ii. of vol. xxxv. of Gegenbaur's *Morphologisches Jahrbuch*, Prof. B. Hatschek, of Vienna, commences a series of studies on the theory of the primitively segmental structure of the vertebrate skull, dealing in this instance with the anterior extremity of the spinal neural system of the lancelet. Dr. Fleischmann's series of papers on the morphology of the cloaca and related organs in the amniote vertebrates is continued by Messrs. H. Dimpfl and J. Schwarztrauber, who respectively discuss these structures in the guinea-pig and the sheep. In a long paper Mr. G. Ruge brings to a conclusion an elaborate series of studies of the external form of the liver in the Primates, dealing in this instance with the monkeys of the Cercopithecus group. As might have been expected, these display a very generalised character in respect to this organ, which is markedly different from that of the anthropoid group. Among other papers on vertebrate morphology is one by Mr. H. Braus on the question whether the formation of the skeleton is dependent on the muscular layer, and a second, by Prof. G. Jelgersma, on the origin of the vertebrate eye. For the conclusions in both these cases we must refer our readers to the original papers, as they are too long to be given here.

The authors of a forthcoming monograph upon "Eclipse"—the famous racehorse—ask us to announce that they would be very glad to be informed of any references to this celebrated horse in contemporary literature; to his breeder, the Duke of Cumberland; to his purchaser, Wildman; and to his subsequent owner, Dennis O'Kelly. The monograph will be as completely illustrated as possible from contemporary paintings and engravings and other sources, and will contain detailed photographs of the

anatomy of "Eclipse" and the most famous of his descendants, which should prove interesting both to biologists and breeders. It is important that information should reach the authors before June 1 if possible, and all letters, manuscripts, prints, or pictures addressed to "Eclipse," c/o Mr. W. Heinemann, 21 Bedford Street, London, W.C., will be acknowledged before that date, and will be treated with the greatest care.

Mr. Henry S. Wellcome, of Snow Hill Buildings, E.C., is organising an exhibition in connection with the history of medicine, chemistry, pharmacy, and the allied sciences, and has issued a circular indicating the range of the proposed exhibition. The loan of any objects of interest is solicited; these will be insured and carriage paid both ways. The date of the proposed exhibition has not yet been definitely settled.

In the *Comptes rendus* of the Paris Academy of Sciences (April 2, p. 823) M. Lortet gives an account of an examination of the contents of four vases containing the viscera of King Rameses II., the Sesostris of the Greeks, who is believed to have died about 3164 years ago. Profs. Hugounenq, Renaut, and Rigaud were associated with M. Lortet in the examination, and three of the vases were surmised to contain the stomach, intestine, and liver of the great king preserved with soda and aromatic resinous substances, and enclosed in linen bandages. A fourth jar contained the heart of the monarch, hard and horn-like, but on microscopical examination showing the typical bundles of muscle fibres of cardiac muscle, crossing one another.

In the April number of the *Monthly Review*, Mr. Paul Uhlenhuth writes on the blood-relationship of man and apes, and describes how, by means of the precipitin test, various albuminous substances and the blood of different animals may be distinguished from one another. The test has also considerable medico-legal importance, and biologically may be employed to ascertain the relationship of various animals to one another. In this way it may be shown that the anthropoid apes are most nearly akin to man, while the lemurs are but distantly, if at all, related to him.

Some years ago Dr. A. Gallardo advanced a dynamical interpretation of the karyokinetic figures in cell division that was explained in Nature of November 13, 1902, by Prof. M. Hartog. Dr. Gallardo has somewhat modified his former theory, and applying the results obtained from a study of the properties of colloids, he postulates in a paper published in *Annales del Museo Nacional de Buenos Aires*, vol. xiii., a negative charge for the chromatin and a positive charge for the cytoplasm around the poles of the spindle. In proof of his theory the writer reproduces the figures obtained with special apparatus on a metallic plate forming one electrode in an electrolytic solution.

It is remarkable that, despite the numerous investigations during the last ten to twenty years into the coffee-leaf disease caused by species of Hemileia, the complete life-history of the fungus has not been worked out. Mr. G. Massee directs attention to the want of information concerning the æcidial stage in his revision of the genus published in the Kew Bulletin, No. 2, 1906. Four species, two of them recently determined by Mr. Massee, are described, and the probability of the æcidial stage is considered. In addition to an announcement regarding the publication, and a list of the contents of a volume on the "Wild Fauna and Flora of Kew Gardens," a supplementary list of fungi prepared by Mr. Massee is given, among which three species new to science are described and illustrated.

According to the *Pioneer Mail*, the Bombay Government has decided that arrangements should be made for the starting of experiments in the cultivation of rubber plants both in the southern and northern circles, and in the garden of economic botany which is about to be established in Bassein. In the northern circle Mr. Ryan has been requested to prepare and submit, under the direction of the conservator, a scheme for the plantation of the *Ficus elastica*, and for experiments with a view to ascertain the yield of rubber and its commercial value, and to suggest other rubber plants likely to show good results. At the Bassein garden Mr. Gammie has been asked to prepare a scheme of experiments on a smaller scale with numerous rubber-yielding plants with the object of ascertaining which are the most likely to succeed in the coast districts of the Bombay Presidency. For the southern circle orders have been given for the preparation of a scheme for experimental plantation, more particularly of Hevea, in one or more localities under the direction of the conservator.

Mr. O. F. Cook, in an article entitled "The Vital Fabric of Descent," published in the Proceedings of the Washington Academy of Sciences (vii., p. 301), urges that kinesis is the main factor in the evolution of organisms. "Kinesis is not a mysterious force or mechanism to be sought in reproductive cells; it is a general property of organisms, as gravitation is of matter. And of kinesis we know more than of gravitation. Two factors and two results are already obvious. The factors are heterism, or intra-specific diversity, and symbasis, or inter-breeding in a specific network of descent. . . ." "Natural selection neither originates species nor actuates their further development; progressive change would go on whether selection were active or not, and whether the environment were uniform or not. Nevertheless, selection conduces to adaptation, since by permitting changes in some directions and forbidding them in others, it deflects the specific motion. The workings of natural selection are adequately explained only by the kinetic theory."

In the *Zeitschrift* of the Berlin Gesellschaft für Erdkunde (1906, No. 3) appears the first part of an interesting historical paper on the measurement of geographical areas before the invention of the planimeter, by Dr. W. Schmiedeberg.

The new issue (vol. xix., part i.) of *Mitteilungen aus den deutschen Schutzgebieten* contains papers on the daily variation of temperature and pressure at Windhuk, German South-West Africa, and of temperature at Herbertshöhe, Bismarck Archipelago, by Dr. J. Hann. Dr. P. Heidke contributes a paper on the meteorology of German East Africa, dealing with the means for the years 1899 to 1902 from twenty-two stations.

The April number of the *Bollettino* of the Italian Geographical Society contains an extremely interesting paper, by Dr. Roberto Almagia, on the earliest Italian contribution to oceanography. The pamphlet described is the "Relatione del Mare" of Giovanni Botero, published in Rome in the year 1600, and it is remarkable that not only the main division of the subject into statical and dynamical sections, but the subdivisions of each of these into special parts, follow closely the method of treatment adopted in modern research.

We have received a reprint from the *Numismatic Chronicle* of a paper, by Sir John Evans, K.C.B., describing the silver medal or map of Sir Francis Drake, which commemorates the voyage round the world completed in 1580. Three, or at most four, examples of this medal are known, two of which are in the British Museum and one in Sir John Evans's collection. Sir John Evans agrees with Mr. Miller Christy that the silver map and that which is attached to the work of Peter Martyr, "De Orbe Novo" (Paris, 1587), are from the hand of the same engraver, about whom it is only known that the initials of his name were "F. G."

Two reports (Nos. 107 and 108) have been issued by the British Fire Prevention Committee containing particulars of experimental tests of the fire resistance of concrete floors. The two floors were practically identical in design, and were subjected to the same conditions. The results of the tests were, however, very different according to the concrete aggregate used. The one having Thames ballast concrete for the protection of its steel-work failed, whilst the other, with clinker concrete and coke breeze protection to the girders, remained intact. No independent fire tests on such a scale with floor areas measuring 15 feet by 22 feet have been previously carried out.

At the Institution of Civil Engineers an interesting paper on the resistance of iron and steel to reversals of direct stress was read by Dr. T. E. Stanton and Mr. L. Bairstow on April 10. The results of their experiments, which were carried out at the National Physical Laboratory, may be summarised as follows:—The superiority, in resistance to reversals of stress, of moderately high-carbon steels over low-carbon steels and wrought irons, which was discovered by Wöhler to exist when the rate of reversals was 60 per minute, still holds when this rate is increased to 800 per minute, although, according to Reynolds and Smith's experiments, this superiority no longer exists when the rate of reversals is in the neighbourhood of 2000 per minute. So far as comparisons can be made between the results of the authors' experiments and those of Wöhler and Sir Benjamin Baker, there is no marked reduction in resistance due to raising the rate of reversals to 800 per minute. Experiments in which the ratio of tension to compression varied from 1·4 to 0·72 indicated that between these limits the value of the maximum range of stress was practically independent of the actual values of the limiting stresses in tension and compression. The resistance of the materials in three typical cases of rapid reduction of area of the specimens has been determined. The failure of iron specimens due to the development of the slip-lines of Ewing and Rosenhain into cracks has been determined for the case of direct stress, and the failure of moderately high-carbon steel, due to the development of cracks in the ferritic areas of the structure, has also been established.

Messrs. Archibald Constable and Co., Ltd., will publish shortly a work on "Recent Advances in the Physiology of Digestion," by Prof. E. H. Starling, F.R.S.

Sir Martin Conway has written a history of Spitsbergen which the Cambridge University Press will shortly publish under the title of "No Man's Land."

The London Stereoscopic and Photographic Company, Ltd., has issued a new catalogue of photographic apparatus intended primarily for the use of amateurs. The list is attractively produced and conveniently arranged, and copies may be obtained post-free on application.

The Country Press, 19 Ball Street, Kensington, has published a series of twelve picture post-cards of the leaves of British trees and shrubs showing the exact venation in each case. These cards are intended for the use of children and others taking up nature-study; but it is to be hoped that teachers will prefer to direct the attention of their pupils to the actual leaves of plants, and to encourage the children to collect and study natural objects themselves rather than pictorial representations of them, however correct and artistic these may be.

OUR ASTRONOMICAL COLUMN.

Employment of Selenium Cells during Total Solar Eclipse.—During the total eclipse of August last, the observers at Tortosa made use of selenium cells for the double purpose of determining the variation in sunlight during the progress of the eclipse, and of ascertaining the exact moments of the beginning and end of totality.

As is generally known, the electrical conductivity of selenium increases on exposure to sunlight, being especially sensitive to the less refrangible end of the spectrum; therefore, by placing the cell in series with a battery and a delicate reflecting galvanometer, the amount of light falling on the selenium may be registered by registering the movements of the galvanometer beam of light.

Whilst the decrease of light, during an eclipse, is not *visible* until the eclipse is well advanced, the galvanometer needle at Tortosa was seen to move immediately after first contact, and for nearly an hour showed a uniformly increasing resistance.

Assuming that the light during totality was of the same quality as that obtaining at dawn, the results derived from the observations show that its brightness was about equal to that of the sky some thirty or forty-five minutes before sunrise.

The results obtained regarding the instants at which totality began and ended were very satisfactory, and it is suggested that, by placing similar equipments along the line of totality during future eclipses, far better results could be obtained than by the visual observations hitherto depended upon (*Astrophysical Journal*, No. 2, vol. xxiii.).

Catalogue of Pleiades Stars.—We have received from Dr. R. S. Dugan, of the Princeton (N.J.) Observatory, a copy of the inaugural dissertation presented by him for the doctorate of the Heidelberg University.

This publication contains the magnitudes and mean places (for 1900·0) of 359 stars of the Pleiades group. In addition to the catalogue, Dr. Dugan discusses the methods employed in measuring the plates and reducing the data thereby obtained. A chart of the group, on which the catalogue number of each star is shown, also accompanies the dissertation.

The Total Solar Eclipse of the Sun of January, 1907.—Among the numerous important papers communicated to the meeting of the Astronomical and Astrophysical Society of America, held at New York on December 28–30, 1905, there is one by Prof. David Todd which will probably be found to be of special interest to eclipse observers.

Prof. Todd and Mr. Baker have computed the essential data for ten possible stations, and have discussed the latter and the means of getting to them. It appears that the new railway across Russian territory will afford the greatest facilities for reaching the Turkestan stations, whilst observations will also be possible some 600 miles north-west of Peking. The complete discussion is to be published in the *American Journal of Science* (*Science*, No. 586, vol. xxiii., N.S.).

Observations of Nebulæ.—Since the year 1884 M. Bigourdan, of the Paris Observatory, has been assiduously employed in making a complete survey of nebulæ.

The results of this survey are to be published in five volumes, of which two (iv. and v.), dealing with the nebulæ situated between 14h. and 24h., have already appeared.

At the meeting of the Paris Academy of Sciences held on March 19, M. Bigourdan presented the second part of

vol. i., including the measures of nebulæ situated between oh. and 2h. of right ascension. The first part of this volume will contain the introduction, and will include a full description of the instruments and methods employed in the research.

Vol. ii., including the section 2h.–9h., is to appear soon, and will be followed by vol. iii., giving the results for the region 9h.–14h. (*Comptes rendus*, No. 12).

A LARGE PHOTOGRAPHIC NEBULA IN SCORPIO.—On examining the photographs obtained during his sojourn at Mount Wilson last year, Prof. Barnard found that an immense region near to π and δ Scorpii is occupied by a large nebula which is comparable in size, and in the peculiarities of its several branches, with the great nebula in Orion and the extended nebulosity of the Pleiades.

A short description of this nebula, together with a splendid reproduction of a photograph of it, taken with the 10-inch Brashear lens of the Bruce doublet, is given in No. 2, vol. xxiii., of the *Astrophysical Journal*.

The nebula extends some $4\frac{1}{2}°$ or $5°$ in a north and south direction, and its brightest portion lies about $\frac{1}{2}°$ to the south of π Scorpii.

A striking fact in connection with this object is that all the larger stars connected with it are, as might be expected, of the Orion type.

Prof. Barnard thinks that the branching, straggling character of this and similar nebulæ tends to discredit the accepted form of the nebular theory of stellar evolution, and doubts whether that theory would have ever been constructed if, at the time, our present knowledge of the appearance of nebulæ, as shown by photography, had been available.

CANADIAN TIDES.

A PAPER on tide levels and datum planes on the Pacific Coast of Canada was read recently by Mr. W. Bell Dawson, the engineer in charge of the tidal survey, at the meeting of the Canadian Society of Civil Engineers. The survey of the Canadian waters on the Atlantic side has been in progress now for some years under Mr. Dawson's charge, and has so far advanced that permanent tide gauges have been fixed at several representative parts of the coast, and sufficient tidal observations obtained to enable the Marine Department to issue tide tables for most of the principal ports. The survey has now been extended to the Pacific Coast.

In the paper under notice the bench marks and data used by the Admiralty, the Hudson's Bay Company, and the town authorities on the coast have been connected up by levelling, and the bench marks at Victoria, Esquimault, Vancouver, and other tidal stations referred to one common standard. These levels are given in the pamphlet. The importance of publishing such results is emphasised by the fact that the bench marks of former surveys are now to a great extent useless, because they were never made public, and the level books containing the records of these surveys have been destroyed by fire, and so a large amount of good work has been rendered useless, and subsequent trouble and expense caused.

The tides on the Pacific Coast are peculiar, the leading feature being a pronounced diurnal inequality which accords with the declination of the moon, and is subject to an annual variation with the change in the declination of the sun; also there is an unusually large solar effect relatively to the lunar, especially in the northern part. In some parts of the coast during the greater part of the day there is a long stand or only slight fluctuation near high-water level, with a sharp, short drop to the lower low water which occurs once in the day. Owing to this diurnal inequality the two highest and lowest points in the tide curve for the month may be as much as five days before or after the full and new moon. While the tides on the Atlantic side of Canada follow the phases of the moon, and accordingly the alternations of spring and neap tides are the dominant features, the tides on the Pacific side may be described as declination tides.

The careful study of the tides and of the mean sea-level appears to indicate that this coast is rising at a rate as great as 1 or 2 feet in the century.

THE INTESTINAL TRACT OF MAMMALS.

IN a memoir "On the Intestinal Tract of Mammals" (Trans. Zool. Soc. of London, xvii., part v., December, 1905, pp. 437–536), Dr. Chalmers Mitchell extends to mammals the line of investigation which has already, in his hands, yielded results of great interest when applied to birds, namely, the systematic study of the pattern and arrangement taken by the folds and coils of the intestinal tract. With this object, the author describes the pattern of the intestinal coils in a great number of mammals dissected by him, representing examples of each of the principal subdivisions of the entire class. The descriptions are supplemented by an excellent series of text-figures, which show the arrangements in a semi-diagrammatic, but clear and accurate, manner. In the case of mammals of which the author has not been able to procure specimens for dissection, he quotes from the existing descriptions of other authors such details as apply to the problems which are the object of his investigation. Thus the memoir before us gives an account, which is practically complete, of what may be called the general morphology of the mammalian intestinal tract, that is to say, of that portion of the gut comprised between the stomach and the anus. From his investigations the author arrives at a number of interesting conclusions, of which only a few can be mentioned in the limits of this article.

Starting from an ancestral type of vertebrate, in which the alimentary canal ran a straight course through the body, suspended by a mesentery from the dorsal wall of the body-cavity, the gut becomes thrown into a series of folds as the result of a process of growth, whereby it becomes longer than the straight length between its extreme points. The process of elongation can be traced both phylogenetically, by a comparison of different vertebrate types, and ontogenetically, in the development of any given species. The more or less complicated folding of the gut which results involves the dorsal mesentery, and also the blood-vessels draining from the different parts of the gut, which tend to take short circuits between portions of the gut approximated to each other by the process of folding.

The intestinal tract, in both birds and mammals, is divided into two regions, anterior and posterior, by the outgrowth at a certain point of a cæcum or pair of cæca. Probably in all cases a pair of cæca were primitively present, as is usually the case in birds. In mammals, as a general rule, a single cæcum is formed, but in some cases two complete cæca, or a rudiment of a second in addition to the usual one, still occur. In a few cases, however, all trace of a cæcum has disappeared entirely. The intestinal tract anterior to the cæcum is divisible into two regions, the duodenum and the small intestine, or "Meckel's tract," as the author proposes to call it. The latter represents only a very short portion of the primitive straight gut, not more than two or three body-somites; but in nearly all birds and mammals it becomes the longest portion of the gut, growing out to form the greater part of what is known as the "pendant loop" in mammalian embryology, and is the chief absorbing portion of the gut. The intestinal tract behind the cæcum may be called the hind-gut, and corresponds to a much larger portion of the primitive straight alimentary canal than the duodenum and Meckel's tract together. In birds the hind-gut is relatively very short. In mammals, however, it is always long, sometimes extremely so, and becomes divided into two regions, the colon and the rectum. The colon is often greatly lengthened, and thrown into loops or coils. The rectum may also be considerably lengthened, but, as a rule, it is not very much longer than the portion of the primitive straight gut which it represents.

In certain groups of mammals a very primitive type of intestinal tract is still found. As the author points out, however, likenesses which are due to the common possession of primitive features, once possessed by the whole group, cannot be regarded as evidence of near relationship. Equally useless for proof of affinity are resemblances due to the loss or reduction of parts that were once the property of the ancestral stock. Clues to affinity must rather be sought in resemblances depending on definite anatomical peculiarities that are new acquisitions, and the more

complex these structures, the more convincing the evidence they furnish, since it then becomes so much the less probable that the same anatomical device should have been produced twice than that it should have been acquired once only. In the Artiodactyla, for example, "a definite case of an anatomical peculiarity, so well marked and complex as to be a safe guide to affinity," is seen in the elongation and spiral coiling of the proximal portion of the colon. The Perissodactyla and rodents supply other examples of evolution along a definite radius from the ancestral centre. From his investigations the author deduces inferences of importance for the general theory of evolution, especially as regards the limitation of the possible range of variation of organs in any set of animals which have once come to occupy a particular radius. Further changes and elaborations are then restricted by the past history, that is to say, by the limited material which it has furnished for further specialisation. In this way a simple explanation is given for the definite grooves, recognised by many writers, along which the specialisation of organisms must necessarily move, without having recourse to the assumption of any mysterious directive forces. E. A. M.

SCIENTIFIC REPORTS OF THE LOCAL GOVERNMENT BOARD.[1]

THE first half of the volume under notice is devoted to the medical officer's report, statistical data, and details of various inspections and inquiries by the Board's inspectors. The second half contains reports of the auxiliary scientific investigations carried out for the Board. The first of these is a memorandum by Dr. Theodore Thomson on rats and ship-borne plague. The conclusion arrived at is that "the part played by the rat in transmission of plague to man, although real, falls far short of the importance which has generally been attributed to it." This may be true, but in view of the predominant part played by the rat in the dissemination of plague in the various Sydney epidemics, it is to be hoped that the campaign against this rodent will in no way be relaxed.

Bearing on the same subject, Drs. Haldane and Wade report on methods of rat destruction and disinfection on ship-board. In this especial attention is directed to the Clayton process, in which sulphur is burned at a high temperature, and air charged with the products of its combustion is pumped into the ship's hold. The gas is rapidly fatal to rats and other vermin, and is germicidal to non-sporing microbes, but it does not penetrate a loaded hold well, and has a deleterious action on certain articles. On the whole, however, it seems to be the best method to employ for rat destruction. Dr. Klein details further experiments on the two types, virulent human and less virulent rat, of the plague bacillus differentiated by him and described in a previous report. Dr. Klein also records some interesting observations on the influence of symbiosis on the virulence of microbes.

An important paper on the differentiation of various streptococci and staphylococci is contributed by Dr. M. H. Gordon. Hitherto the differences exhibited by the members of these classes of micro-organisms, particularly the streptococci, have been slight and indefinite, but by making use of culture media containing various mono-, di-, tri-, and poly-saccharides and glucosides, important differential characters are obtainable. Dr. Sidney Martin has continued his studies on the toxic action of microbes, dealing in the present volume with that of the *Proteus vulgaris*. The results, however, in this case are somewhat indefinite, the toxic reaction being mainly evinced by the development of agglutinin in the blood. Dr. Houston gives a detailed report of the bacteriological examination of normal human dejecta, and of the intestinal contents of sea-fowl and of fish. All gulls contained typical *B. coli* in their excrement in enormous numbers, but guillemots did not contain *B. coli* of any sort. As regards fish, those obtained "from a source seemingly above all suspicion of objectionable contamination, may contain sometimes apparently typical *B. coli* in their interior; in the great majority of cases the results were either wholly negative or the microbes that were isolated proved to be atypical in character."

Dr. Alan Green contributes further observations on chloroformed calf vaccine which prove that the quality of the lymph prepared by this method is of a high order.

The above brief review shows that this report contains matter of the greatest interest and importance which should be studied by all bacteriologists and by those to whom the care of the public health is entrusted.

R. T. HEWLETT.

[1] "Thirty-third Annual Report of the Local Government Board, 1903–4." Supplement containing the Report of the Medical Officer for 1903–4

INFRA-RED SPECTRA.[1]

THE record of an enormous amount of work on the absorption spectra of organic compounds and emission spectra of various metals and gases in the infra-red region is given in the volume under notice. The investigations were commenced whilst the author was a graduate student at Cornell University, and completed under the auspices of the Carnegie Institution of Washington.

Even to summarise the mass of valuable information contained would exceed the limits of our present space, but it may be said at once that, to workers along similar and related lines, these results, and the descriptions of the apparatus and methods whereby they were obtained, are indispensable.

Part i. occupies nearly seven-eighths of the whole volume, and deals with the absorption spectra of 131 organic compounds up to 15 μ. As is pointed out in the very complete historical review, all previous workers in this subject have abandoned the investigation at 7 μ for the alcohols and 10 μ for some few other compounds.

The description of the apparatus and methods is exhaustive and invaluable. From 0·8 μ to 2·5 μ a quartz prism was employed, beyond that, and up to 15 μ, one made of rock-salt. The source of the radiations was a Nernst lamp "heater," which gives a spectrum of which the energy curve is smooth and continuous. A reflecting spectrometer of 35 cm. focal length was employed for the explorations of the spectrum up to 15 μ, and a considerable portion of the work up to 7·5 μ was repeated with a spectrometer of 1 m. focal length.

The distribution of the energy in each spectrum was determined by means of a radiometer similar to that devised by Nicholls, but with some modifications.

The principal reasons for this investigation were the determination of the influence of molecular weight upon absorption spectra, and also the effect of molecular structure. The results show that in different compounds each of these causes in turn acts separately, whilst in other compounds the absorption is produced by the combined effect.

In recording the quartz-prism results the author deals separately with each absorption band in the nineteen compounds investigated, whilst in the other results the compounds are treated separately, notes being made of the chemical structure and properties of each substance where necessary.

Numerous tables set out the numerical results in various forms, whilst 140 full-page *transmission* curves show them graphically. In addition to these the author has written seven brief appendices dealing with side-issues in connection with the apparatus and the investigation and its results.

In part ii. Mr. Coblentz deals with the infra-red emission spectra of various metals, metallic chlorides (alkalies), and gases. The metals were employed as the poles for the arc producing the radiations, whilst the chlorides were volatilised on carbon arcs. The apparatus was very similar to that described in part i., except for a few modifications rendered necessary by the greater intensity and unsteadiness of the radiations.

With the metals, a black-body spectrum due to the oxides, and sufficiently strong to obliterate any emission lines which might be present, was found, and in the alkali chloride spectra no lines were discovered beyond 2 μ. Of the gases investigated—in vacuum tubes—N was found to be the only one having strong emission lines in its infra-red spectrum. CO_2, CO, and the vapour of C_2H_5HO were

[1] "Investigations of Infra Red Spectra." By William W. Coblentz. Pp. vi+331. (Washington, D.C.: The Carnegie Institution, 1905.)

found to exhibit a very strong emission band at 475μ. The emission spectrum of C_2H_5OH shows that a vapour in a vacuum tube can emit a continuous spectrum.

Ångström's conclusions—deduced from the fact that the total radiation *increases*, while the luminous radiation *decreases*, with increase of pressure in the gas—that there are two kinds of radiation present during the electrical discharge are found to be in close agreement with the observed facts. These different discharges were named "regular" and "irregular" (*i.e.* luminescence) by the previous observer. An interesting theoretical discussion of the action of pressure in this connection is given in the volume.

W. E. R.

DISEASES OF VINES.[1]

TWO parts of the *Annales de l'Institut Central Ampélologique Royal Hongrois*, devoted to two of the vine diseases, have lately reached us.

In one of these parts (part iii.) an account is given of the little known disease caused by the attacks of *Phyllosticta Bizzozeriana*. The disease was first noticed in the year 1900, and it has been kept under observation since then, with the result that its spread has been traced in some detail. The symptoms are somewhat similar to those of the dreaded "black-rot," but it does not appear as if it will prove so dangerous a parasite. In addition to a brief life-history of the fungus, illustrated by an excellent plate, a useful compendium of the species of Phyllosticta occurring on the vine is given.

Part iv. contains an unusually complete account of the "grey-rot" caused by *Botrytis cinerea*. This is one of the parasites of the vine which the cultivator most dreads. All aërial parts of the host-plant are attacked indiscriminately, and quickly become covered with a greyish or brown mould, which produces enormous quantities of ashy-grey spores. This stage is succeeded by the formation of small black sclerotia in the diseased tissues of the stems, leaves, and fruits. Naturally the fungus has been investigated time after time, but the researches of Istvanffi, published in this volume, have added a number of fresh facts to our knowledge of its life-history. In the first place, a series of laboratory investigations was made with the object of determining the conditions under which the fungus brought about the infection of the host-plant. The optimum temperature for the germination of the spores proved to be 25° C., whilst the spores were killed by exposure to a temperature of 38° C. to 41° C. The effects of drying the spores were then investigated. One day's drying over sulphuric acid at laboratory temperatures, either in light or darkness, was sufficient to kill 75 per cent. of the spores, and desiccation for thirty-six days was fatal to all of them. Spores previously germinated and exposed to this treatment suffered still more severely. The results of freezing were again seriously to diminish their germinating capacity.

The action of a number of the commoner fungicides on spores was then examined, with interesting results. Thus a 1 per cent. solution of Bordeaux mixture only prevented the germination of some 60 per cent., and a 10 per cent. solution about 10 per cent. Spores which were allowed to dry after soaking in Bordeaux mixture all failed to germinate. Others sown in drops on the foliage of the host-plant not only germinated, but infected the tissues below them. On examining the action of the constituents of this mixture, lime water proved to be singularly efficacious in preventing germination.

In the majority of these experiments the spores of Monilia and of Coniothyrium were exposed to the same conditions, with results, on the whole, similar to those already quoted. At the same time, the life-history of the fungus was traced in detail. Istvanffi succeeded in germinating the sclerotia, and has settled the point once for all that they do give rise to the apothecia of *Sclerotinia fuckeliana*. So many observers have failed to obtain this ascigerous stage that it is well to have this definite statement. The sclerotia retain their germinating capacity for at least twenty-one months. Another interesting point brought out in the course of this research is that the well known adpressoria of the fungus are the early stages in the development of the sclerotia. In addition to the microconidia observed by Brefeld and others, Istvanffi records the production of an oidial stage.

For further details, and for methods to be adopted for checking the spread of this pest, the original must be consulted. It is full of points of interest to the student of plant pathology, and makes one regret more and more that this country possesses no institute similar to the Central Ampélologique Royal Hongrois, where the pressing problems of plant disease can be adequately examined. Here we have to trust to the private individual for what investigations are made, and he all too rarely has opportunities to make them on the comprehensive scale possible at such an institution.

[1] "Annales de l'Institut Central Ampélologique Royal Hongrois," tome iii., livre 3 and 4, 1905. (Budapest, 1905.)

EARTHQUAKE ORIGINS.

AMONG the most interesting and important of the new ideas, which have been introduced into seismology, in late years, must be classed Major E. G. Harboe's notion of the nature of earthquake origins. Originally treated as a point, the focus of an earthquake has long been recognised as an area, but we are still in the habit of regarding it as restricted in size and small in comparison with the dimensions of the area over which the earthquake is felt. On this hypothesis the decrease in violence is correlated with increase in distance, and due to a gradual diminution of intensity as the disturbance travels from its origin; according to Major Harboe's conception, the focus of an earthquake is no longer restricted in size, but ramifies, with a varying degree of initial violence, over nearly the whole of the seismic area.

On the generally accepted hypothesis the coseismal lines should more or less correspond with the isoseismal, a decrease in violence being accompanied by an increase of time interval, but such is far from being the case, and we have been in the habit of attributing the irregularities to errors of observation; Major Harboe has now shown that another explanation is possible, and that the irregularities in recorded times almost disappear if his hypothesis of the nature of the origin is adopted. From the discussion of the records of earthquakes he reaches the conclusion that the true rate of propagation of the sensible shock is about 0·4 kilometre per second, the higher velocities obtained by other investigators being compounded of the rate of propagation of the disturbance along the origin, and that of the wave-motion set up by this disturbance.

This rate of propagation is that of the sensible shock, which can be felt by human beings, and not that of the large waves recorded by seismographs outside the seismic area proper; the latter, the rate of propagation of which is about 3 kilometres per second, are regarded as different in character, and propagated in the consolidated rock at some little depth below the surface, the sensible shock being due to quite superficial waves propagated through the more fissured and less coherent surface rocks.

One of the weightiest of the objections to this hypothesis was the value of $3{\cdot}28 \pm 0{\cdot}05$ km. sec. obtained by Profs. Sekiya and Omori in 1902 from the seismic triangulation started by Prof. Milne in 1884. This is dealt with in vol. viii., part iii., of Gerland's *Beitrage zur Geophysik*, where Major Harboe remarks that, in spite of the long period over which the observations extended, only four earthquakes seem to have given usable records from all the stations, three earthquakes at three stations, and one at two stations. Taking two of these earthquakes, for which records from a number of meteorological observatories have been published, he finds that the velocity and direction of propagation, deduced from the triangulation, lead to most discordant results at other stations, irregularities which disappear if a branch of the origin is supposed to have traversed the field of triangulation and the disturbance to have spread outwards to the stations.

Whether the hypothesis stands the test of future investigation or not, it seems to explain many previously inexplicable anomalies, apart from those of time. It appears to work out satisfactorily in the case of those earthquakes by which Major Harboe has attempted to test

it, but the only true testing must be left to investigators of the future, for it is to be feared that in the past seismologists have been inclined to reject, as bad, all records of time which failed to fit in with their preconceived ideas of the direction of propagation of the shock, though they might have fitted in with a less simple, though possibly truer, conception of the form and extent of the earthquake origin.

R. D. Oldham.

CURRENTS IN THE STRAITS OF MESSINA.

For our knowledge of the physical conditions at the bottom of the sea we are very largely beholden to the enterprise of submarine cable companies; indeed, it is difficult to imagine a more thoroughly satisfactory method of survey than that employed by them. Duties connected with the maintenance of cables have led to the discovery of details in the configuration of submarine gullies, of fresh-water outlets beneath the sea, and of alterations in the bed of the ocean itself, which would otherwise have eluded observation. Prof. Platania, of the Istituto Nautico of Catania, has directed attention to another rather surprising fact, namely, that in the Straits of Messina there are deep-water currents of sufficient velocity to cause the interruption of the cables joining Sicily with the mainland ("I cavi telegrafici e le correnti sottomarine nello stretto di Messina," reprinted from the *Atti della R. Accademia Peloritana*, vol. xx.). The period under observation covers the last forty years, during which time there have been twenty-six interruptions; neglecting two, nineteen occurred between November and April, and five between May and October. The strong currents cause a continual attrition by sand and pebbles. The rocks on the sea bottom are swept free of mud and sand, and their rough surfaces, thus exposed, have worn out the cables lying upon them. In one case a cable seems to have been corroded by a sulphurous spring. The surface currents attain a speed of five miles an hour. They have always been a danger to navigation, and the wrecks of two large vessels which were lying last summer upon the Sicilian shore show that Scylla and Charybdis have lost none of their power. The existence of correlated strong deep-water currents had been suspected. Biologists have long been attracted to Messina by the plentiful harvest of deep-sea animals which are occasionally brought up to the surface by a vast turmoil of waters, thus affording almost unique opportunities. M. Thoulet and others have repeated the classical experiments of our countryman, Captain Richard Bolland, made in 1675 in the Straits of Gibraltar, and have demonstrated the existence, at twenty fathoms, of an undercurrent flowing in a contrary direction to that on the surface, but these currents have not yet been as systematically studied as the importance of the subject demands. The tides, as is frequently the case in narrow straits, as, for instance, inside the Isle of Wight, are doubled.

A PERIODICAL FOR PALÆONTOLOGISTS.

This new venture in scientific literature,[1] which is to appear quarterly, and leads off with a double number, will be warmly welcomed by all palæontologists, for since the "Annales des Sciences Géologiques" ceased to exist, there has been no accredited journal for palæontology in France. The "Annales des Sciences Naturelles: Zoologie," it is true, has on occasion offered the hospitality of its pages, but the whole of its space is not too great for the living subject.

Material enough and to spare lies ready to hand at the Paris Museum in collections from all parts of France and its colonies, while it is further intended to carry on D'Orbigny's incompleted tasks begun in his "Paleontologie Française" and "Prodrome de Paléontologie stratigraphique universelle." The publication of illustrations of the yet unfigured types of the latter work, with reprints of the author's diagnoses, accompanied by notes and explanations, an undertaking of great merit, is begun in this first part.

As regards guiding principles, the editor, while not wishing in any way to dictate to his contributors, gently suggests in his introduction that he has preferences. On the one hand, he seeks memoirs on stratigraphical or purely systematic palæontology, in which the principal object will not be the multiplication of genera and species, holding as he does that *mieux valent des choses sans noms que des noms sans choses.* On the other, he inclines to papers having a philosophic bearing.

With his former predilection all must be in accord, while of the latter, the very first paper, one by the veteran Albert Gaudry, "Fossiles de Patagonie. Les attitudes de quelques Animaux," is an excellent example, where "attitudes" is used to express the comparative bearing, gait, and appearance, and not posture alone. The author points out that in Tertiary times in Patagonia Plantigrades and Rectigrades predominated over Digitigrades.

The editor and M. A. Thevenin give the first instalment of a series of memoirs on the palæontology of Madagascar, in which they deal with the molluscan fauna from newly discovered Upper Cretaceous beds on the eastern side of the island. Some of the species enumerated are identical with those found by the Rev. R. Baron in the northern and north-western districts, that were described by Mr. R. B. Newton in the Quart. Journ. Geol. Soc. for 1889 and 1895, a fact to which, however, allusion is not made. This fauna presents considerable analogy with that which lived during the same epoch in India.

The second contribution to the same series, by M. Douville, treats of some nummulitic beds in Madagascar.

M. Boule adds a memoir on "Les grands Chats des Cavernes," principally the lion, that takes the form of a popular review of current knowledge on the subject.

The part concludes with the opening portion of the descriptions and figures of D'Orbigny's types already referred to.

Altogether there are 100 pages of text, with nine phototype plates, besides abundant illustrations in the text, all the figures being most excellent, and veritable works of art.

There is, indeed, but one objection to raise, and that is against the adoption of dual pagination, each paper having its distinct pagination in addition to that of the volume, because the disadvantages of this system for purposes of citation far outweigh any possible benefits.

It is to be hoped that the glossy surfaced paper selected, so suitable for modern text illustrations, though not for type of the face employed, is not of that perishable description which we have been lately warned will deprive future generations of the fruits of our intellectual labours.

B. B. W.

[1] "Annales de Paléontologie, publiées sous la direction de Marcellin Boule." Tome i. fasc. 1 and 2. January, 1906. Pp. xi+100; 9 plates. (Paris: Masson et Cie.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The special board for mathematics has put forward new proposals, both with regard to the mathematical tripos and the mechanical sciences tripos, which involve far-reaching changes. The first-named report points out that in the opinion of the special board the existing mathematical tripos is unsatisfactory as an examination. The special board proposes to substitute for the present part i. a new part i., which may be taken by a student either at the end of his first or second year. Part i. will not qualify for a degree without further examination. It is hoped that this part will be taken by many who propose to proceed later to study engineering or natural sciences. The board further proposes that for the existing part ii. a new part ii. be established, which must be taken at the end of the third year. The position of senior wrangler is abolished, but the class list of each part will contain three classes, the names in each class being arranged alphabetically. Schedules are published for each of the proposed new parts.

With regard to the report of the mechanical sciences tripos, the special board of mathematics suggests that part ii. of the tripos should be abolished, and it is proposed to modify part i. by the inclusion of a number of

papers on questions of greater difficulty or of wider range than the average of those now set. The other papers of this part are, however, to be made easier than the present average. The board hopes to include a paper on chemistry in the future. It is also considered to be desirable that the examiners should be empowered to take into consideration the laboratory and drawing-office work done by the student during his course; but perhaps the most important of the recommendations is that every candidate for the mechanical sciences tripos, unless he has obtained honours in one of the honours examinations of the University, must pass a qualifying examination in elementary mathematics and mechanics, which will be held twice a year.

The special board for biology and geology has renominated Mr. F. A. Potts, of Trinity Hall, to use the University table at Naples for four months from April 1. Applications for the use of this table and for that at the Marine Biological Association's laboratory at Plymouth should be sent in to the chairman of the special board (Prof. Langley) on or before May 24.

Dr. Haddon is giving a special course of lectures on magic and savage religion on Mondays during this term.

PROF. FRIEDRICH CZAPEK, of the Prague Technical High School, has been appointed professor of botany in Czernowitz University. Prof. Armin Tschermak, of the University of Halle, has been appointed professor of physiology and medical physics in the Veterinary High School, Vienna.

IT is announced by *Science* that Adelbert College, Western Reserve University, has received 30,000*l.* from the grandchildren of Mr. Joseph Perkins, formerly a trustee of the college. The money is to be used for a department of sociology and a chemical laboratory.

ON Commemoration Day at Glasgow University on April 18 the honorary degree of Doctor of Laws was conferred upon Mr. James S. Dixon, founder of the lectureship of mining in the University, and Mr. R. E. Froude, superintendent of the Admiralty experimental works at Haslar.

ALTHOUGH we are far behind other nations in governmental recognition of the claims of anthropology, the universities, the older ones leading the way, are following their Continental sisters in making it a subject of systematic study by providing courses of instruction and establishing diplomas and other distinctions. The Oxford committee for anthropology has just issued the regulations for the diploma and the list of lectures for the next two terms. It is pointed out by the committee that not only members of the university, especially those whose work will bring them in contact with native tribes, will benefit from the newly-established course of study, but also those already in contact with native races who feel the need of extending their anthropological knowledge during their "long leave." The schedule of lectures shows that although no provision can yet be made for systematic instruction covering the whole of the very wide field in even a summary manner, students who present themselves are sure of finding helpful and stimulating teaching in all the more important branches of the subject: the chief omission at present is the failure to include social organisation, usually a crux for missionaries and the untrained generally, among subjects on which aid may be sought. The secretary of the committee is Mr. J. L. Myres, Christ Church, from whom all information may be obtained.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"A Further Communication on the Specificity and Action *in vitro* of Gastrotoxin." By Dr. Charles **Bolton**.

An analysis in the test-tube of the gastric cytotoxin obtained by injecting the rabbit with guinea-pig's stomach cells has shown that it is a complex body. After a single injection there is a great increase in the hæmolysin normally occurring in the rabbit's blood, and after further injections an artificial hæmolysin makes its appearance. The artificial hæmolysin is distinguished from the natural hæmolysin, because the former can be complemented by guinea-pig's normal blood serum, whereas the latter cannot. There is also present in the immune serum a substance which agglutinates the red blood corpuscles. Closely associated with the appearance of this artificial hæmolytic immune body is that of an agglutinin which acts upon the gastric granules, and also that of a precipitin which acts upon the soluble proteids of the gastric cells. By repeating the injections these substances are found to be present in the blood for several months. Whether they are one and the same or distinct bodies has not yet been proved. After several injections, and not less than about five weeks from the first, a further substance appears in the blood, which possesses an action upon the intact gastric cells. In spite of repeated injections this substance disappears from the blood in about four months. It is probably of the same nature as a hæmolysin, but this point requires proof.

The hæmolytic factor is only active against blood. The actions of the agglutinin and precipitin are not confined to the constituents of the gastric cells, but extend to other proteids of the body. Whether there are separate agglutinins and precipitins for different proteids, or whether the same substances act upon all proteids, has not been determined; at all events, if the same bodies are concerned in all cases, their action upon the proteids of the stomach cells is probably greater than that upon other proteids. Whether the gastrolysin itself is truly specific remains to be proved.

The few experiments that have been undertaken in the case of the human stomach indicate that the human gastric cytotoxin is identical in constitution with that of the lower animals.

February 8.—"Explosions of Coal-gas and Air." By Prof. Bertram **Hopkinson**.

The explosion of homogeneous mixtures of coal-gas and air at atmospheric pressure and temperature is investigated by means of platinum resistance thermometers placed at various points in the explosion vessel. The vessel is of dumpy cylindrical form and 0·2 cubic feet capacity, and the mixture is fired by an electric spark at the centre. Each thermometer consists of a loop of bare platinum wire about 5 centimetres long and 1/1000th inch diameter, which is placed in series with a battery of constant potential and a reflecting galvanometer, of short periodic time, the deflection of which is recorded photographically on a revolving drum. On the same drum the pressure of the gas is recorded. The arrival of the flame at any wire is marked by a sharp rise in its resistance, and the rate of rise, when corrected for the time lag of the wire, gives a measure of the velocity with which the gases about it combine. It is found that with a mixture consisting of one volume of gas and nine of air the flame spreads from the spark in a somewhat irregular manner, but at a rate of roughly 150 centimetres per second. A thermometer placed near the spark shows a sudden rise of temperature to about 1200° C., after which the temperature remains nearly constant until the flame approaches the walls of the vessel. With the rapid rise of pressure which then occurs the adiabatic compression of the burned gas at the centre causes the temperature there to rise to about 1900° C., with the result that the wire of the thermometer generally melts. At a point near the walls the gas is compressed to near the maximum pressure before ignition, and the temperature consequently rises suddenly to 1200° C. or 1300° C., and as there is little subsequent compression there is not much further rise of temperature. Thus, in consequence of the different treatment of the gas at different points in the vessel, differences of temperature of 500° C. exist in the gas at maximum pressure after an explosion of this kind. That such differences must necessarily exist after an explosion even in a vessel impervious to heat does not appear to have been noticed hitherto. These differences are rapidly obliterated by convection currents, but their magnitude at the moment of maximum pressure is such as to make it impossible to obtain an accurate estimate of the specific heat from the pressure record after the manner of Messrs. Mallard and Le Chatelier. The work of these experimenters is not, however, open to the chief objection that has hitherto been urged against it, viz. that combustion was incomplete when they measured the specific heat. The experiments here described show that the combustion at any point is prac-

tically finished 1/40th of a second after it begins, and that 1/30th of a second after the attainment of maximum pressure the gas in the vessel may be regarded as a mixture of CO_2, steam, and inert gases in chemical equilibrium.

The pressure of the ignited gas at the centre of the vessel is increased during the spread of the flame from one atmosphere to six. During this time it loses no heat, and the rise of temperature observed is from 1200° C. to 1900° C. It follows that between these limits of temperature the average value of γ for these gases is 1·25.

With a weaker mixture containing one volume of gas and twelve of air the spread of the flame is very much slower, about $2\frac{1}{2}$ seconds elapsing before all the gas is burned. Owing to the slow propagation of the flame, convection currents play an important part during the process of ignition; the burned gases rise to the top of the vessel, and the last portion of gas to be ignited is not close to the wall, but immediately under the spark, and a short distance from it; but though the flame is propagated very slowly, the combustion of any given portion of gas, when once started, proceeds almost as rapidly as in the stronger mixture. There is no "after-burning" in the sense of the slow completion of a reaction already begun. Within 1/10th of a second before the time of maximum pressure some gas is still unburnt; within 1/10th of a second after all the gas is completely burned, and the mixture everywhere in chemical equilibrium.

Incidentally, the difference of temperature between a fine wire immersed in the gas and the temperature of the gas is determined by comparing the temperatures of two wires, one having double the diameter of the other, placed close together in the same explosion. The error due to radiation is thus found, and it is shown that if a wire 1/500th of an inch in diameter is getting hotter at the rate of 1300° C. per second, then it must be 200° C. colder than the gas surrounding it. The results are used to find the actual temperature of the gas from that of a wire 1/1000th of an inch diameter immersed in it, and the conclusion is drawn that the temperatures in a gas-engine cylinder cannot be obtained by the use of a wire thicker than this, except by applying corrections amounting to several hundred degrees centigrade.

The bearing of the results on the question of "after-burning" in the gas engine is discussed, and it is shown that the high specific heat of the products of combustion, together with some loss of heat during the passage of the flame through the compression space, accounts for all the peculiarities of the gas-engine diagram. The form of diagram obtained with weak mixtures is due simply to the very slow propagation of the flame, and not to any delay in the attainment of chemical equilibrium at a point which the flame has already reached.

March 15.—"A Discussion of Atmospheric Electric Potential Results at Kew, from selected Days during the Seven Years 1898 to 1904." By Dr. C. **Chree**, F.R.S.

The paper contains an analysis of atmospheric electricity results at Kew on selected fine-weather days—usually ten a month—from 1898 to 1904.

All days were excluded when rain fell or negative potential was recorded. All data are given in absolute measure (volts per metre). The diurnal inequalities for individual months and the year are represented by curves. These all show two distinct daily maxima and minima. The minima always occur near 4 a.m. and 2 p.m. The times of the maxima are more variable, the day interval between the two being longer in summer than in winter.

The highest mean potential gradient occurs in December. Whilst the amplitude of diurnal inequality is greatest in mid-winter, the ratio in which it stands to the mean daily value is then least. The diurnal inequalities for the several months are analysed in 4-wave Fourier series. The 12-hour term is, in general, the most important; the changes in its amplitude and phase angle throughout the year are comparatively small. The 24-hour term is much larger in the winter than in the summer months, and its phase angle varies greatly. Attention is also given to the phenomena of individual days. The difference between the highest and lowest hourly values averages two and a half times the amplitude of the regular diurnal inequality, and is fully larger than the mean value for the day.

Of various meteorological elements temperature is found to have much the most marked influence, high mean potential and large diurnal range of potential being associated with low temperature in every month of the year, except the hottest (July).

An appendix compares the diurnal inequalities of potential and barometric pressure. Diurnal inequalities were got out for each month of the year for the barometric pressure at Kew for an 11-year period. The similarity between the diurnal inequalities of the two elements is found to be confined to the 12-hour terms; the 24-hour terms present diametrically opposed phenomena in the two cases. The afternoon minimum and evening maximum of potential are in every month notably in advance of those of barometric pressure. If any relationship of cause and effect exists between the *regular* diurnal changes in the two elements, the pressure change would seem to be the effect, the potential change the cause.

Geological Society, April 4.—Mr. R. S. Herries, vice-president, in the chair.—A case of unconformity and thrust in the Coal-measures of Northumberland: Prof. G. A. L. **Lebour** and Dr. J. A. **Smythe**. The sections described occur on the coast north of the Tyne, near Whitley Sands, between Table Rocks and Briar-Dene Burn. The base of the "Table-Rocks Sandstone" is found to rest unconformably upon a series of alternating shales and sandstones, among which is a well-marked band of clay-ironstone crowded with *Carbonicola acuta*, one of those "mussel-bands" which are found to be perhaps the most remarkably persistent strata in the north of England Carboniferous rocks.—The Carboniferous succession below the Coal-measures in North Shropshire, Denbighshire, and Flintshire: Dr. Wheelton **Hind** and J. T. **Stobbs**. This paper opens with a critical account of previous research among the Carboniferous rocks of North Wales. Then follows a detailed account of the various beds, exposed in numerous quarries worked for road-metal, iron manufacture, lime, cement, chert, or building-stone. Fossil lists are given from each exposure of importance. A range table is given of the chief brachiopods and corals, and the palæontological sequence is compared with that occurring at Bristol and in the north of England.

Chemical Society, April 5.—Prof. R. Meldola, F.R.S., president, in the chair.—An improved apparatus for measuring magnetic rotations and obtaining a powerful sodium light: W. H. **Perkin**, sen. The improved apparatus consists of a short but very powerful coil carrying a powerful electric current. The coil is cased with steel, and has a 3-inch gun-metal tube through the centre, the interior of this being the position of the magnetic field. The glass measuring tubes are supported in this tube in a metal trough which can be kept at any required temperature. A method of obtaining a powerful sodium light was described, which consists in heating a platinum boat containing sodium chloride by a small oxygen-coal gas flame. This causes the sodium chloride to volatilise, and the vapour, passing into a flame produced by a large Bunsen burner, gives a very intense, yellow light, which can be maintained for a long time.—The rusting of iron: G. T. **Moody**. The explanation of rusting as a process involving the production of hydrogen peroxide, as advanced by Dunstan, is directly negatived by experimental evidence, which shows that atmospheric corrosion results first from the interaction of iron and carbonic acid, whereby ferrous salt is formed, and subsequently from the more or less complete oxidation of ferrous salt by oxygen. It is found, moreover, that the composition of iron rust is not fairly represented by the formula $Fe_2O_2(OH)_2$, as stated by the foregoing investigator.—The estimation of carbon in soils: A. D. **Hall**, N. H. J. **Miller**, and N. **Marmu**. The soil is treated with chromic acid, and the resulting gases passed over a short length of copper oxide. The carbon dioxide formed is absorbed by alkali and estimated by double titration.—Electrolysis of salts of $\beta\beta'$-dimethylglutaric acid: J. **Walker** and J. K. **Wood**.—Bromo- and hydroxy-derivatives of $\beta\beta\beta'\beta'$-tetramethylsuberic acid: J. K. **Wood**.—Some new *o*-xylene derivatives: G. **Stallard**.—A new solvent for gold, preliminary note: J. **Moir**. The author finds that gold-leaf dissolves fairly readily when floated on an acid solution of ordinary thiocarbamide, and solution

is accelerated by the presence of an oxidising agent. The gold compound produced forms brilliant, colourless, six-sided lozenges, and contains 45·4 per cent. of gold.—The molecular condition in solution of ferrous oxalate, a correction: S. E. **Sheppard** and C. E. K. **Mees.**—Acetyl and benzoyl derivatives of phthalimide and phthalamic acid: A. W. **Titherley** and W. L. **Hicks.**—The dynamic isomerism of phloroglucinol: E. P. **Hedley.** The following conclusions were established:—(1) that in neutral solutions phloroglucinol exists in both modifications, the enol being greatly in preponderance over the keto-form; and (2) that this equilibrium is undisturbed by the class of solvent.—Studies in asymmetric synthesis, v., asymmetric syntheses from *l*-bornyl pyruvate: A. **McKenzie** and H. **Wren.**—*l*-Methyl*cyclo*hexylidene-(4)-acetic acid: W. H. **Perkin,** jun., and W. J. **Pope.**—Condensation of benzophenone chloride with α- and β-naphthols: G. W. **Clough.** —The constitution of coerulignone (cediret), a preliminary note: J. **Moir.**—A comparative crystallographic study of the perchlorates and permanganates of the alkalis and the ammonium radical: T. V. **Barker.** On comparing the perchlorates with the permanganates, it is found that the effect of replacing an atom of chlorine by one of manganese is much the same as that induced by the substitution of sulphur by selenium, say, in the sulphates of the same metals. The crystallographic evidence for placing manganese in the seventh group of the periodic classification, so far as such evidence goes, is therefore of the strongest possible kind.—Contribution to the theory of isomorphism based on experiments on the regular growths of crystals of one substance upon those of another: T. V. **Barker.**—Constitution of salicin. Synthesis of pentamethylsalicin: J. C. **Irvine** and R. E. **Rose.** It is shown that salicin (and hence also helicin and populin) contains the same γ-oxidic linking as the methylglucosides and sucrose.—A product of the action of *iso*amyl nitrite on pyrogallol: A. G. **Perkin** and A. B. **Steven.** The main bulk of the product formed in this reaction has the composition $C_6H_4O_3$, and it appears likely that it may consist of hydroxy-*o*-benzoquinone.—A reaction of ellagic and flavellagic acids: A. G. **Perkin.** Ellagic acid is oxidised by sulphuric acid to a compound having the formula $C_{14}H_{16}O_{10}$. Flavellagic acid yields a similar oxidation product.—Some thio- and dithio-carbamide derivatives of ethyleneaniline and the ethylenetoluidines: O. C. M. **Davis.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 26.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

SOCIETY OF ARTS, at 4.30.—Seistan, Past and Present: Colonel A. H. McMahon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Flame Arc Lamps: L. Andrews.

MATHEMATICAL SOCIETY, at 5.30.—Perpetuants and Contraperpetuants: Prof. E. B. Elliott.—(1) A Question in the Theory of Aggregates; (2) The Canonical Forms of the Ternary Sextic and Quaternary Quartic: Prof. A. C. Dixon.—On the Question of the Existence of Transfinite Numbers: P. E. B. Jourdain.—Some Theorems connected with Abel's Theorem on the Continuity of Power Series: G. H. Hardy.—On a Set of Intervals about the Rational Numbers: A. R. Richardson.—On Two Cubics in Triangular Relation. Prof. F. Morley.—On the Accuracy of Interpolation by Finite Differences: W. F. Sheppard.

FRIDAY, APRIL 27.

ROYAL INSTITUTION, at 9.—Ore Deposits and their Distribution in Depth: Prof. J. W. Gregory, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: Louis Greaven.

PHYSICAL SOCIETY, at 5.

AËRONAUTICAL SOCIETY, at 8.—The Use of the Balloon in the National Antarctic Expedition: Captain Robert Falcon Scott, R.N.—The Experiments of the Brothers Wright: Sir Hiram S. Maxim.—The Carrying Power of Aeroplanes: M. José Weiss.

MONDAY, APRIL 30.

INSTITUTE OF ACTUARIES, at 5.—Reversionary Securities as Investments: C. R. V. Coutts.

TUESDAY, MAY 1.

SOCIETY OF ARTS, at 4.30.—Social Conditions in Australia: Hon. J. G. Jenkins, Agent-General for South Australia

ZOOLOGICAL SOCIETY, at 8.30.—Additional Notes on Anthropoid Apes, with Exhibition of Specimens: Hon Walter Rothschild.—On Mammals collected in South-west Australia by Mr W. E. Balston: Oldfield Thomas, F.R.S.—On the Lepidoptera collected during the Recent Expedition to Tibet: H. J. Elwes, F.R.S., and Sir George Hampson, Bart.

WEDNESDAY, MAY 2.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fourteenth "James Forrest" Lecture: Unsolved Problems in Metallurgy: R. A. Hadfield.

SOCIETY OF ARTS, at 8.—Submarine Signalling: J. B. Millet.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Estimation of Fat in Homogenised Milk: H. Droop Richmond.—Milk Analysis: H. Droop Richmond and E. H. Miller.—Note on the Composition of Saffron: A. E. Parkes.—On the Polenske Method for the Detection of Cocoanut Oil in Butter: Dr. S. Rideal and H. G. Harrison.—On the Presence and Detection of Cyanogen in Java and other Beans: R. R. Tatlock and R. T. Thomson.—On the Examination of Linseed, Olive and Other Oils: R. T. Thomson and H. Dunlop.

THURSDAY, MAY 3.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: On a Static Method of Comparing the Densities of Gases: Prof. R. Threlfall, F.R.S.—The Stability of Submarines: Sir William H. White, K.C.B., F.R.S.—The Action on Bacteria of Electrical Discharges of High Potential and Rapid Frequency: A. G. R. Foulerton and A. M. Kellas. —The Action of Pituitary Extracts upon the Kidney: Prof. E. A. Schäfer, F.R.S., and P. T. Herring.

ROYAL INSTITUTION, at 5.—The Digestive Tract in Birds and Mammals: Dr. P. Chalmers Mitchell.

CHEMICAL SOCIETY, at 8.30.—The Relation between Absorption-Spectra and Chemical Constitution, part v.: The *iso*Nitroso-compounds: E. C. C. Baly, E. G. Marsden, and A. W. Stewart.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Malonate, part ii.: W. H. Perkin, jun., and J. L. Simonsen.—Brazilin and Hæmatoxylin, part vii., Some Derivatives of Brazilein: P. Engels, and W. H. Perkin, jun.—Pipitzahoic Acid: J. M. Sanders.—The Constitution of the Hydroxides and Cyanides obtained from Acridine, Methyl-acridine and Phenanthridine Methiodides: C. K. Tinkler.—The Constitution of Ammonium Amalgam: E. M. Rich and M. W. Travers.—Action of Light on Potassium Ferrocyanide: G. W. A. Foster.

LINNEAN SOCIETY, at 8.—Origin of Gymnosperms (*Continuation of Discussion*): Dr. D. H. Scott, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Some Observations on Bacterial Tank Operations: Dr. W. O. Travis.

CONTENTS.